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NOTES AND COMMENTS

The Museum of Practical Geology

The House of Commons Committee on the museums of the Science and Art Department has reported unanimously in favour of transferring the collections of rocks and fossils from the museum in Jermyn Street to South Kensington. The removal of the collections from the present headquarters of the Geological Survey has long been foreseen as inevitable. Those who know the conditions under which the vast accumulation of specimens, constantly being added to by the energetic officers of the Survey, is housed, and the difficulties of space, lighting, and so forth under which the scientific staff of that establishment has to work, as well as the great danger from fire, will not regret the removal of the collections and offices to some safer and more spacious quarters; least of all we imagine will such a change be objected to by the members of the Survey themselves. It is no doubt possible that some of the public, who find the present Jermyn Street Museum within easy reach, may complain of its removal to the wilds of South Kensington; indeed, protests have already been raised. But really it is more important that all the specimens should be accessible to a few than that only a few of them should be accessible to many.

But before expressing a final opinion upon this recommendation of the Committee, we should like to know what they mean by South Kensington, or even that portion of it which they designate as "on the west side of Exhibition Road." We will take it for granted that they do not mean the Imperial Institute, although even that establishment has found defenders lately. Neither do we suppose that it is contemplated to make a simple translation of the Museum of Practical Geology along with the offices of the Survey; for although there is ground still unoccupied at South Kensington, it is already appropriated for the future growth of institutions already on the spot. The intention, therefore, must be to incorporate the collections of the Survey with one or other of the existing museums

at South Kensington, while keeping them available for constant and ready reference by the officers of the Survey. The Geological Survey, of course, has always been a branch of the Science and Art Department, and it might be supposed that the natural incorporation would be with what is usually called the South Kensington Museum, to which many of the models and appliances formerly at Jermyn Street have already been transferred. But it must be remembered that the scientific collections of the South Kensington Museum do not embrace objects of natural history, except in so far as they are definitely connected with education. The natural history collections of the country are preserved in the British Museum, in that branch of it now generally known as the Natural History Museum. It would therefore seem more fitting that the collections in question should be placed in the keeping of the Trustees of the British Museum.

We do not know exactly how the proposed alteration by the Committee will be received by those already in possession at the South Kensington Museum and at the Natural History Museum. We can imagine the existence of a little jealousy, counterbalanced by the fear of being overburdened with work; and we can understand that there should be considerable indisposition to yield valuable space without an equivalent return. With these matters an independent scientific Review has no concern. It is our part to consider what is best for the public and for the advance of science. Now, it is generally recognised that, in spite of the ardent efforts of the two or three hard-working gentlemen whose business it is to name fossils at Jermyn Street, the lists of fossils that are published by the Survey in its memoirs are not so reliable as they might be. We do not for a moment blame the gentlemen just referred to. They do as much as the difficulties of their position permit them; the fault lies with the system. What we want to see is the training of a school of broad-minded specialists, whether amateur or professional, and the co-operation of those specialists in the advancement of British palaeontology. Only in this way are the fossils of our strata likely to be identified with sufficient exactitude to be a true guide to the practical geologist and the miner; only thus shall we ever solve those wonderful problems of detailed stratigraphy and palaeo-geography, the very existence of which we are just beginning to realise; only thus will fresh light be thrown on the fascinating enigmas of the procession of life. It is obvious that the nucleus of such a band of specialists already exists at the Natural History Museum, and nowhere else; and that museum is already the headquarters of many palaeontological specialists who are not on its staff. There, too, is to be found in greatest completeness that indispensable aid, a good library. Therefore, it seems to us that

what is wanted is to bring those specialists and the facilities they possess into touch with the Survey collections. This, of course, would involve the increase of the staff of the British Museum, at least by the addition of the palaeontologists of the Survey, and, if good work be really desired, by two or three more.

We do not advocate, and we do not know anyone that advocates, the severance of the Survey collections from the surveyors, whose publications must always be based on the evidence of these particular rocks and fossils; and no one can be desirous of distributing the geological collections among those already in the British Museum, which latter are arranged primarily in accordance with zoological classification. Such a distribution would be a severe blow to the study of geology, and would quite do away with any advantage that might be gained by the change of site. No! the great need already at the Natural History Museum is for a geological and stratigraphical series. This gap might be filled by the Jermyn Street collections. We should like to see the erection of the eastern wing of the Natural History Museum, and the installation therein of a museum of stratigraphic and dynamical geology, chiefly illustrating the history of our own islands. We would have a stratigraphical series more complete and detailed than at present is possible at Jermyn Street. What an object-lesson it would be to see the faunas of every zone displayed in an ascending series! What an impulse it would give to more exact geological investigation, and how enormously this in its turn would benefit the students of the different taxonomic groups, both of animals and of plants!

There is, as we said at the beginning, little doubt that the recommendations of the Committee will be carried out in one way or another before very long. In what precise way and with what spirit remains to be seen. We believe that the greatest improvement will be effected by a change on the lines here sketched out, if only that change can be made without harmful friction.

Mr Herbert Spencer on Polar Bodies: a Postscript

To the article on Cell-Physiology published in our May number, Mr Herbert Spencer wishes to add a paragraph, containing (so he writes to us) "a clinching argument." It runs thus:—"A test fact remains. Sometimes the first polar body extruded undergoes fission while the second is being formed. This can have nothing to do with reducing the number of chromosomes in the ovum. Unquestionably, however, this change is included with the preceding changes in one transaction, effected by one influence. If, then, it is irrelevant to the decrease of chromosomes, so must the preceding

changes be irrelevant: the hypothesis lapses. Contrariwise this fact supports the view suggested above. That extrusion of a polar body is a process of cell-fission is congruous with the fact that another fission occurs after extrusion. And that this occurs irregularly shows that the vital activities seen in cell-growth and cell-multiplication now succeed in producing further fission of the dwarfed cell and now fail; the energies causing asexual multiplication are exhausted and there arises the state which initiates sexual multiplication."

A Quilted Squid

The general zoological results of the Swedish expedition to Tierra del Fuego were described in our own pages by Dr Axel Ohlin. The collections made were entrusted to specialists, and the detailed conclusions are now being issued as they are completed in an octavo publication entitled, "Svenska Expeditionen till Magellansländerna." Of this we have just received Vol. ii., No. 4 (pp. 49-64, pls. iv., v.), which is an account of the Cephalopoda by Dr Einar Lönnberg. The species collected were *Octopus fontanianus*, d'Orb.; *O. patagonicus*, n. sp.; *Gonatus antarcticus*, n. sp., which appears to be the southern representative of the northern *G. fabricii*; and two almost complete specimens of *Onychoteuthis ingens*, E. A. Smith (1881), of which only the head was known previously. Through the courtesy of Dr Lönnberg we are able to present our readers with the portrait of one of these specimens (Plate XI.).

The chief interest of Dr Lönnberg's paper lies in its account of the integument of the last-mentioned species. The surface of the mantle and of the head presents a peculiar warty appearance, like a cobble-stone pavement. This is due to the presence of large subcutaneous papillae, between which the skin has sunk after being placed in formalin. The structure of the mantle is thus described, from within outwards: A thick coat of circular or transverse muscles; a thin layer of longitudinal muscles; a layer of connective tissue of about the same thickness, and containing a large number of cell-corpuscles, nuclei, and blood-vessels; on this are situated the papillae, which rise with steep sides from a broad base, and have a flat upper surface; between the papillae is delicate connective tissue; lastly, outside the papillae, comes the skin proper, consisting of connective tissue, muscles running in various directions, chromatophores, and epithelium. The papillae have a height of 1 millimetre or a little more, but vary in size and shape, some having a diameter of 2·5 millimetres, others as much as 5 millimetres. Each papilla is limited by thin but dense layers of elastic fibrils and fibrils of connective tissue. The main mass of the papilla is a network of thin, long, wavy, elastic fibrils, which enclose large irregularly

elliptical meshes, in which are large round connective tissue cells; the structure is penetrated by blood-vessels and rather large nerves, and appears to be surrounded by circular muscles, which can contract the area but increase the height of each papilla. The connective tissue between the papillae contains large oval cells in a gelatinous matrix supported by a network of very fine fibrils; it contains many fat-corpuscles.

The function of this peculiar quilted padding is not obvious. The abundance of nerves in the papillae leads Dr Lönnberg to regard it as a sensory organ for noting changes of hydrostatic pressure, and he compares it with the 'terminal papilla' of *Spirula reticulata*. The oily fat stored up in the layer is probably to be explained as reserve material.

Nothing precisely like this papillose layer has ever been described, although there is a "thick glassy-looking subcutaneous layer" in *Mastigoteuthis levimana*, and a gelatinous tissue with elastic fibrils and regulating muscles in *Alloposus mollis*, while certain "lenticular, glandular bodies" observed by Steenstrup in several species of *Ommatostrephes* may be similar papillae. There is, however, one form upon which the observations of Dr Lönnberg throw unexpected light. Not long ago Dr L. Joubin, under the name *Lepidoteuthis*, described a squid supposed to be covered with solid scales, forming "une véritable cuirasse qui donne à l'animal un aspect étrange, rappelant certains poissons Ganoïdes ou la carapace de divers fossiles." The specimen came from the stomach of a sperm-whale, and Dr Lönnberg maintains, with much show of reason, that the supposed scales are "only subcutaneous papillae from which the covering skin has been removed by the influence of the digestive fluids." In fact Dr Joubin's own description of the 'scales' accords exactly with Dr Lönnberg's description of the subcutaneous papillae.

Cheese to Order

While Messrs Babcock & Russell, as explained in our March number (p. 151), have been working towards the conclusion that the omnipresent microbe has less to do with the maturation of cheese than is usually supposed, that, in short, the whole process can be accomplished without his aid, an energetic experimenter on this side of the Atlantic, Dr Olav Johan Olsen of Norway, has done something more than to rehabilitate the cheese-bacteria; he has actually put them into harness, and an account of his success is contributed by his assistant, Miss Thora Scheel, to the March number of *Naturen*. Hitherto, cheese has been left to do its own fermenting by means of such bacteria as its varying constituents, the temperature and moisture of its store-house, and

various external conditions might permit. Dairymen had an idea of the proper course to pursue under the special circumstances of their locality; but they worked blindfolded, and their calculations were liable to be upset by unregarded variations of environment. Dr Olsen has changed all this. He has investigated various cheeses, and has caught and cultivated their microbes; then he has reversed the process, and used his cultures to produce the various cheeses from which he started. The kinds of microbes are not many, but by their combinations in different proportions, different results are obtained. First there are the common fermentation-microbes, common to all cheese, but replaceable, as Babcock & Russell have shown, by unorganised ferments. Then come the species that affect the diagnostic characters of the future cheese, its peculiar taste and smell. Cheesemaking now goes by the card. The milk is sterilised and heated to 70°-75° C., and the store-room is kept guarded against foreign microbes. Those that are desired are added in the requisite proportions, and their vigorous growth is of itself enough to overcome the influence of accidental strays. The production of the kinds of cheese is no longer an affair of the laboratory; but Dr Olsen will take your order for Gorgonzola, Stilton, or Camembert, and will furnish the precise description required at a cost satisfactory to your pocket and to his own. Norway is a land specially adapted to the industry of cheesemaking, and as Norwegian prophets differ from those of other countries in securing the hearty recognition of their countrymen, there is no doubt that Dr Olsen's discoveries will be rapidly taken up in practice. We wish therefore to draw the attention of the British farmer to them without delay.

Fishy Water

We referred in our last number to a paper by Messrs Jackson & Ellms on "Odours and Tastes of Surface Waters." We learn from *The Plant World* that the city of Brooklyn, N.Y., has had much trouble with its drinking water, complaint being made, especially during the summer months, of its objectionable appearance, strong oily taste, and what Trinculo would have called its "very ancient and fish-like smell." The causes of this condition have been investigated by Professor Leeds, of the Stevens Institute of Technology. He finds that the whole trouble is due to the presence, in immense numbers, of a diatom, *Asterionella flavor*. In some samples of water as many as twenty million individuals to the gallon were found. "Think of it; drink of it then if you can." This diatom is enclosed in the usual silicious skeleton, and has the power of secreting a substance in the nature of an oil, which possesses the

peculiar taste and smell above described. This oily, taste-producing substance is volatile, and cannot be got rid of by distillation. The water itself was found to be colourless, the apparent colour being due to the suspended organisms. The problem of purification of the water is naturally an important one. Filtration was of no avail, and aerating it only tended to aggravate the mischief. The sole remedy that has proved effectual so far is that of excluding the light, and converting the reservoirs into subterranean basins; for *Asterionella* cannot live in darkness.

Sampling the Herring Pond

During the trip to America in connection with the British Association meeting at Toronto last year, Prof. Herdman made a continuous collection of the little free-swimming organisms constituting the plankton, both on the outward and homeward journeys. The method adopted for this purpose was that of placing nets over a tap and over-flow pipe bringing water from the bottom and top respectively of a tank kept full of sea-water by a pump working continuously. The material strained from the water thus passing through the nets was collected twice daily and preserved for detailed study. The examination has since been made and the results published in the *Transactions* of the Liverpool Biological Society (Vol. xii. pp. 33-90). From the lists of species there given, a very good notion of the more important of the smaller kinds of organisms inhabiting the North Atlantic during the summer may be obtained. One can also perceive the changes which occur in the character of the plankton from point to point, although this would have been much more readily seen if the results had been issued in tabular form. The Copepoda, which form the most important constituent of the collections, have been specially worked out by Messrs I. C. Thompson and A. Scott, and include three species new to science. These latter, however, were taken not in the open Atlantic, but in the St Lawrence.

As remarked by Prof. Herdman, this method of collecting samples of the surface fauna, even from an ocean-liner going at full-speed, will enable naturalists to obtain, at very slight expense, a series of gatherings across the great oceans in every direction traversed by passenger or cargo steamers. The ship's surgeon, or any other officer who may be willing to take charge of a net and set of collecting bottles for a marine biologist, can now help in making an interesting series of observations which may lead to important conclusions as to the distribution of oceanic organisms. And as the Copepoda at least are edible (some were actually cooked and eaten during the trip) the cook has here the means of adding a new dish, or at any rate a sauce, to the bill of fare.

The Drift of the Channel

THE paper of most interest in the last number of the *Journal of the Marine Biological Association of the United Kingdom*, issued at the end of April, is a "Report on the Surface Drift of the English Channel and Neighbouring Seas during 1897," by Mr W. Garstang. It will be remembered that about a year ago the Director of the Plymouth Laboratory instituted an investigation by means of soda-water bottles, which were cast upon the waters, and which, we are glad to say, were in a large number of cases returned to him after many days. The locality where each bottle started upon its journey was accurately recorded, as well as the date on which it started. By means of a numbered post-card enclosed in the bottle, information as to the place reached by it, with some indication of the date, was returned to Mr Allen. The whole Report is of remarkable interest, but we must confine ourselves here to quoting the conclusions in Mr Garstang's own words :—

"Enough has been said, I think, to show that the method employed here for tracing the actual influence of the winds on the water is sufficiently accurate for practical purposes, and that by its employment, with proper precautions, the influence of the winds may be separated from that of other factors which operate in the production of surface currents. From this point of view the method may be of considerable use in the future for determining the existence of currents not produced by local wind-action. At the same time the method requires to be tested extensively before it can be used as a basis for conclusions. The present report pretends only to show that the relation between wind-action and surface currents is capable of quantitative study, and that the results obtained by the use of the methods here described are sufficiently accurate to encourage the further use of them. This we are doing during the present year on a larger scale, and the results will be set out in next year's report. It is very desirable that experiments should be made to determine the depth of the currents induced by wind-action, and we propose to attempt this work during the present year. A comparison of results obtained by bottles floating at the surface, and by other objects designed to come under the influence of lower strata of water, should yield results of considerable value. Until such experiments are made, however, it does not appear to be desirable to say too much upon the practical aspects of the experiments described in this report. We have obtained a general view of the movements of the uppermost layer of water, and we may be certain that similar, though slower, movements also affect the layers immediately subjacent; but the actual depth to which this movement would be communicated under different conditions of wind and tide

is a matter of too much practical importance to be left to mere guesswork. As Mohn has well said: 'Neither argument nor estimate, but carefully worked-out computations alone, can lead to a lasting result.'"

The Protection of Birds

Following on the action of the Massachusetts' State Legislature, noticed in our last number, the United States Senate has passed a bill for the protection of song-birds, providing that the importation into the United States of birds, feathers, or parts of birds, for ornamental purposes be prohibited, and prohibiting the transportation or sale of such articles in any territory of the United States or in the district of Columbia. Considering that the American lady can no longer bring in cheap sealskins or wear a *matinée* hat, this last blow will probably have the effect of seriously decreasing the female population of the United States.

At a recent meeting of the New York Academy of Sciences Mr W. T. Hornaday related the results he had obtained in reply to questions circulated by him in all parts of the United States with reference to the destruction of bird life. It appears that the most destructive agencies are sportsmen, plume-hunters, boys after eggs, pot-hunters, fire, and English sparrows; and through these it has been estimated that there has been a decrease of 46 per cent. during the last fifteen years. It is shown that game and edible birds are becoming scarce, and that song-birds are being used for food in their stead; that plume-birds are becoming extinct, and that destructive agencies are increasing. Mr Hornaday concluded with an appeal for more drastic measures in the game-laws, and for their careful enforcement.

Turning to our own country, we note that the indefatigable Secretary of the Society for the Protection of Birds has induced a score or so of prominent ornithologists to pen a series of brief but practical pamphlets intended for the man on the street, who has seldom much anxiety to preserve wild birds from the hand of the destroyer. The names of such accomplished naturalists as Messrs O. V. Aplin, H. E. Dresser, J. A. Harvie Brown, Howard Saunders, and T. Southwell are a sufficient guarantee that the majority of these papers are first-rate. They are published at the office of *Knowledge*, 326 High Holborn, London, W.C., and we wish all success to their circulation.

Desirous of bearing our part in the crusade against the 'Arrietts of 'igh-life, we hope to publish before long an article on "Milliners' Birds," written by a well-known ornithologist. This will afford some guidance to those who have sympathy but lack knowledge.

A New Hybrid Grouse

The irregular alliances contracted by the *Tetraonidae* have long afforded interest to students of the European game-birds. Even in Great Britain we meet with hybrids between the Black and Red Grouse, the Black Grouse and Capercailzie, and the Pheasant and Black Game, while in recent years the interbreeding of the Capercailzie with the common Pheasant of our Scottish coverts has been proved beyond all shadow of doubt. But it is in Northern Europe that the birds of this family are commonly recognised as prone to lapse from strict virtue and produce mule offspring, usually the hybrids between the Capercailzie and Blackcock, called 'Rackel-Fogel' in Sweden. The latter species occasionally mates successfully with the Willow Grouse; indeed, the interbreeding of these two species was pointed out by a Norwegian naturalist as long ago as 1795, and, at a later date, received a careful investigation at the hands of Prof. R. Collett. This fact increases the importance of the brief report which that distinguished naturalist has now drawn up upon a hybrid between the Blackcock (*Tetrao tetrix*) and Ptarmigan (*Lagopus mutus*), and published in *Bergens Museums Aarbog* for 1897. The specimen in question was secured in 1896 by the Bergen Museum, which previously contained other hybrids of great interest. We refer especially to a hybrid between the Willow Grouse and Capercailzie, acquired in 1889, and described by Mr J. A. Greig, whose paper was accompanied by a photograph of this remarkable specimen (cf. *Bergens Museums Aarsberetning* for 1889, No. 5).

Mammals of Norway

Another valuable paper that we have received from Prof. Collett is the third instalment of his "Remarks on Norway's Mammal-fauna," and deals with the years 1882-1897. (*Nyt. Mag. for Naturvidenskaberne*, vol. xxxvi. pp. 264-374.)

This memoir contains a clear and concise account of the forty-seven species of indigenous and three of introduced mammals which occur at the present time in Norway. The subject-matter is well arranged, the paragraphs on habits interesting but not over-lengthened, details of measurements are given, fortunately in millimetres, and the nomenclature (except in one or two trifling cases) is up to date—a recommendation which we had almost ceased to look for in local faunas. Altogether, we have little but praise to offer to this Fauna, and we can only regret that the language in which it is written must make it a closed book to many English naturalists.

The mammals of Norway must always be of interest to a wide circle of readers, since in that country the sportsman may still find

the brown bear, the stag and roedeer, elk and reindeer, whereas the naturalist, content with smaller though to him not less interesting game, may trap quite a large number of the European Insectivora and Rodentia. To the Pinnipedia, too, Norway is a favoured home. But perhaps the most interesting of Norwegian mammals are the Norway lemming and the beaver—the former on account of its present restricted range and peculiar migrating habits, the latter because of its great rarity as a European mammal. Of both these animals, however, Prof. Collett has recently given full accounts, to which we have referred in previous volumes. The absence from Norway of such a wide-spread animal as the common brown hare is worth noting again, but this deficiency is compensated for by the presence of a numerous series of interesting Carnivora in the northern lynx, the glutton, the wolf, and the bear. Not by any means the least interesting parts of Prof. Collett's paper are the tables giving the number of these animals killed from the year 1846 onwards; and from these we gather that, whereas the number of wolves killed for the five years 1846-50 was 1120, the corresponding number for 1891-98 was only 273. Yet the figures given for the glutton would almost lead us to imagine that this animal had increased of late years, since the number killed during 1846-1870 is considerably less than that given for the years 1871-1895. Certainly the wild Carnivora, at least in Norway, are not becoming extinct at so rapid a rate as many people suppose to be the case.

Notes on Norwegian Geology

Prof. C. F. Kolderup makes three geological contributions to *Bergens Museums Aarbog* for 1897. In the first ("Ekersunds-Soggendalsfeltets bergarter og deres betingelser for anvendelse i stenindustrien"), he points out the practical applications of the rocks that he has previously described from the neighbourhood of Ekersund, in the extreme south-west of Norway. Among these are red, grey, and violet labradorite-rocks, with only trifling admixtures of hypersthene, biotite, and ilmenite; the red variety seems specially available for commercial purposes, lying as it does upon the actual sea-board. The norites do not stand the weather so well; they are grey in their fresh state, and include the well-known rock of Hitterö. Now that Norwegian granitoid rocks are partially displacing the well-tried Scotch ones in the London market, and are already popular for tombstones, a paper of this kind is very timely, and may even help to assure men of business of the 'practical' bearings of geological mapping and research.

The second paper is still more to the point as a sermon to the 'practical' man; for it correlates the deficiencies in the bones of cattle in certain parts of the Ekersund area with the small amount

of phosphoric acid revealed by the bulk-analysis of the rocks. As much as 2 per cent. is present in the region occupied by the norites and monzonites, and here the cattle have well-developed bones; the ·3 per cent. of P_2O_5 where the hornblende-granite series prevails is sufficient to check disease in some measure; but the bad district, from the farming point of view, coincides with that of the labradorite-rocks, which contain only ·002 per cent. It is almost quaint to find the appearance of apatite in microscopic sections employed as an argument for the choice of pasture-lands.

In a third paper ('Et orienterende niveau i bergensskifrene"), Prof. Kolderup describes a new fossil-locality at Aasen in Samnanger, which leads him to correlate the limestones of that locality, and their associated rocks, with the well-known altered Silurian rocks of Bergen.

Each paper is conveniently accompanied by an abstract in German.

Recent Work on the Foraminifera

Before enumerating the more recent papers on this group of animals it will be well to call attention to three papers which are likely to be overlooked, from the fact that they are all Inaugural Dissertations. The first, by Friedrich Sellheim, is entitled "Beitrag zur Foraminiferen-kenntnis der fränkischen Juraformation," and was published at Erlangen in 1893. This tract of 34 pages is accompanied by a plate in which fig. 17, *Frondicularia parallela*, is a new form. Many others are described as new species, but they do not seem to us to be worthy of such a position. The second paper "Geognostische Beschreibung des Rathsberger Höhenzuges" (Erlangen, 1896) is by Alfred Bettinghaus, and the Foraminifera occur as a list from the Amaltheenmergel (Lias δ). Karl Mittermaier, the author of the third paper, which is also published at Erlangen, 1896, writes on "Der Mikrofauna der oberen Kreideschichten von Transkaukasien." This paper calls for no special notice, except that his *Nodosaria subconstricta* and his *Glandulina panicea* are the same form, which seems to differ from anything we have seen before from the Chalk.

It is refreshing to turn to the concluding paper on the "Foraminifera of the Gault," by Frederick Chapman, which brings to an end a valuable and perfect monograph on the subject. We hardly know whether to congratulate the author or the Royal Microscopical Society the most, for the Society has most liberally seen the author through with a piece of work which will be a classic. The present paper deals with the Rotalines, and the odds and ends which have come to light during the progress of the work. There is a brief note on the Gault of Folkestone and its continental equivalents, followed by a biblio-

graphic note, a summary of results on the zoological and zonal distribution, and a complete distribution table showing the occurrences of the Foraminifera throughout the whole of the Folkestone Gault at intervals of 5 feet. Mr Chapman has also found time to issue a note on the forms found in the Hartwell clay (*Proc. Geol. Assoc.*, July 1897); to show that the proper specific name of *Saccammina carteri* is really "*fusulinaformis*" of M'Coy, 1849 (*Annals Mag. Nat. Hist.*, March 1898); to join with Prof. Rupert Jones in a masterly resumé of the whole of that singular genus *Polymorphina* (*Journ. Linnean Soc. Zool.* 1896); and to write several other papers of considerable interest. He also undertook the section Protozoa in the Zoological Record, to which his contribution in conjunction with Dr Frazer Hume appeared in the volume for 1895.

Dr R. M. Bagg has given us a detailed description of the Foraminifera in the Tertiary and Pleistocene beds of the Middle Atlantic Slope (*Bull. Amer. Paleont*, vol. ii., Ithaca, N.Y., March 1898). American forms being so little known, this paper is the more valuable, and we hope Mr Bagg will dip further into the subject. The chief things to notice are a new *Spiroplecta*, *S. clarki*, and *Spirillina orbicularis*. Fifty-seven forms are enumerated.

Dr Carlo Fornasini continues his descriptive work, and among his papers are two in the *Rendiconti R. Accad. Sci. Ist. Bologna*, 1897, which discuss the work of J. B. Beccari and O. G. Costa respectively.

Mr J. J. Lister deals in the *Proceedings of the Royal Society*, 1897, with "a possible explanation of the quinqueloculine arrangement of the chambers in the young of the microspheric forms of *Triloculina* and *Biloculina*." As is well known from the researches of Mr Schlumberger, the young of the megalospheric form of *Biloculina* commences with a large chamber, the later chambers being disposed on either side of a single axis; while in the microspheric forms of the same genus, the young begins with a small chamber, and the later chambers are disposed on a rotating axis, that is to say, the plane dividing any single chamber symmetrically is not identical with the corresponding plane of the preceding chamber, but directed at a definite angle to it. It appears possible that, in the first case, the reproduction is asexual and in the latter sexual, but Mr Lister confines himself to suggestion for the present (*vide ante*, p. 58).

Finally, Dr Ludwig Rhumbler, of Göttingen, has a series of notes on the double-shelled Foraminifera, on reproduction and on structural peculiarities of Protozoa generally, which he published in the *Biologisches Centralblatt* early this year.

Flowers and Insects

Sir John Lubbock in a recent contribution to the Linnean Society's *Journal* (*Botany*, vol. xxxiii. pp. 270-278) adversely criticises some

conclusions of Prof. Plateau on the relations between insects and flowers. Under the title "Comment les fleurs attirent les insectes" (see *Bull. Acad. Bruxelles*, 1895, 1896, 1897), Prof. Plateau described numerous experiments which in his opinion prove that insects are not attracted by the form or colour of flowers, but by their scent. Sir John argues that these experiments were incomplete, and would, moreover, often admit of conclusions exactly opposite to those drawn. For instance, single dahlias were used in several cases. Squares of coloured paper with a central hole were pinned over the head of flowers so as to hide the ray-florets, which are generally considered to form the attractive portion, while revealing the yellow honey-containing centre. Prof. Plateau did not find that the bees neglected the partly protected heads. But, as Sir John points out, the paper discs, of red, violet, white, or black, must have been very conspicuous, and the insects were, moreover, used to visiting the bed, and could, therefore, soon find the not inconspicuous yellow hearts of the partly covered flowers. When the whole heart was covered with the paper or with green leaves, and even when all the flowers were masked, the insects still came, which, Prof. Plateau says, proves conclusively that they were attracted by the smell. But against this it is suggested that, first, the flowers were only covered above, not completely hidden; secondly, that a bee which has got used to visiting a spot for honey will hunt about for the honey when it is hidden; and thirdly, that as dahlias have, so far as we can perceive, no scent, "it is somewhat illogical to assume that the bees are guided by the sense of smell, when we have no evidence that any scent is emitted." Even if it were proved in his experiments that the insects were attracted by smell, which undoubtedly they are in many cases, and that they did not see the ray-florets, this would not prove that they are not guided by the colour petals when they can see them. In reply, Sir John adduces some experiments of his own to test the respective attractions of scent and colour. A hive-bee was trained to come to a certain spot on a table for honey. The honey was then removed and on one side of the spot was placed a drop of honey on a glass slide, and the great brilliantly blue bracts plucked from a flower-head of *Eryngium amethystinum;* at an equal distance (one foot) on the other side was placed a similar drop of honey, and a far less conspicuous flower-head, which had been deprived of its bracts. During three successive days the visits of the bee were noted, and it was found that of ninety-three visits, it came sixty times to the honey near the bracts, and thirty-three to that near the flower-head. After each visit the head and bracts were transposed to eliminate any possible difference in the two samples of honey. These experiments go far to disprove Prof. Plateau's conclusion

that the colours of flowers are not a source of attraction for insects.

Polyembryony in Seed-Plants

By a communication to the *Botanical Gazette* (April) Mr W. F. Ganong adds another to the already somewhat numerous instances of the production of more than one embryo in the embryo-sac. The case is that of the prickly pear *(Opuntia vulgaris)*. The plants had been growing and flowering luxuriantly in the Botanic Garden of Smith College, Northampton, Mass., for at least four years, and set seed each year in great abundance. About half of the seeds when sown produced more than one seedling, and there was the greatest variation in the number, size, and degree of union with one another of the seedlings. Investigation showed that the embryos originate as described by Strasburger for *Funkia*, and as has since been shown to be the usual method where polyembryony occurs, from the cells of the nucellus, the original tissue of the ovule. The egg-cell shrivelled and disappeared. The question arises as to the significance of polyembryony. The writer argues that it is too distinct and elaborate a process to be explained as mere budding, as Strasburger and Pfeffer suggest, and that the variety in the place of origin of the embryos from egg-cell, synergids, antipodal cells, or nucellus, preclude the idea of its being a relic of some older condition, or a case of apogamy. On the other hand, it may be the beginning of something new. "Its origin in several distinct groups and by several distinct methods seems to imply that there is some virtue in the development of the extra embryos, and that their appearance is controlled by that influence, whatever it may be, which is much more powerful than mere morphological inertia, and which elsewhere forms new structures from the most different morphological origins." Its independent appearance in distinct groups may be compared with the appearance of heterospory.

Vaccination in Japan

While vaccination is under the consideration of our legislators, it may be interesting to note that it is compulsory in Japan, and that re-vaccination must be undergone every five years. We learn from the *Revue Scientifique* that the process was introduced into that country in 1849 by a Dutch physician, Nagayo (which seems to us less of a Dutch than a Japanese name), but was first made official in 1871 by the establishment of a vaccination office in connection with the Medical College of the University of Tokyo. The lymph used at that time was derived from the human vaccine imported by Mohnike. But in 1879 a commission was sent to Europe to study the subject, and on

its return an institution for the preparation of lymph twice a year was established. The progress which has since been made in the preparation of lymph in Japan is due chiefly to Dr Kitasato. This is a wonderful advance on the old days, not so old either, when the almost universal remedy for all ills was the mode of cauterization known as the 'moxa.'

The Moco

In a Note that appeared in our May number, and was headed "Geology at Oxford," we used the phrase "when the mocos have gathered round Mr Sollas' head."

It is strange that several of our readers should have been puzzled by this, and should have exposed their ignorance by writing to ask the meaning of 'moco.' One correspondent, who thought that we meant to say 'mokes,' irately protested against the application of such a term to the students of Professor Sollas.

The moco is an animal perfectly well known to all serious zoologists. It is sometimes called the rock-cavy, the Indian name is Hoké, while Moko, the original form of the word, is Portuguese. The correct scientific appellation is *Kerodon rupestris*. The species, which is larger than most other cavies, inhabits the interior of Brazil, and, according to Prince Maximilian who first described it in 1820, "it is confined to rocky districts, where it seeks its retreat in holes amongst the fragments of the rocks." As an adaptation to this habitat, it has thick soles, with short blunt nails. The appropriateness of our allusion in connection with a geologist will not be contested. Moreover, the moco is found near rivers, but always in the higher parts of their course; and its flesh is of a pleasant flavour. It is remarkable among cavies for its dense and soft fur. It has a large nail on the inner toe of the hind foot, and this, G. R. Waterhouse imagines, is used by the animal to clean its fur.

This explanation seemed necessary, for otherwise some readers might have suggested that 'mocos' was a misprint for 'snows.'

The Australian Snipe

This bird has been known to science for nearly a century under the name *Gallinago australis*. From the middle of August to the middle of the following March the bird is to be seen in Victoria, but during the intervening months it migrates to the northern hemisphere, and in consequence its nest and eggs remained unknown until last year. They have been found at last on the slopes of Fuji-yama, the sacred mountain of Japan, about 2500 feet above sea-level. The finder is Mr Alan Owston of Yokohama, but he appears to have been put up to it by Mr A. J. Campbell of Melbourne, as we learn from a report in the *Victorian Naturalist* for March 1898.

I

A Geographical Commemoration

THREE notable explorers have just been commemorated by the nations to which they belonged: the Portuguese Vasco da Gama, the Italian Vespucci, and the Russian Deschnev. They are the real or supposed discoverers of the routes to "east and western Ind" and of the north-east passage. Here are a few notes on them, giving the results of recent investigation.

Vespucci

THE third Congress of the Italian Geographical Association was held at Florence during the week beginning April 12th. The proceedings of the Congress included the celebration of the 400th anniversary of the discoverers Toscanelli and Vespucci, and were accompanied by much festivity. Vespucci's title to our recognition is that he has been regarded by some as the discoverer of the New World, and indeed the name America is supposed to be a slight modification of his own forename. As to that forename, however, there has been some dispute, for there have not been wanting people to take opposite views and to say that Vespucci's forename was really Alberrico, and that he changed it himself, or had it changed by his friends, to Amerrigo or Amerrico in order to make it resemble more closely the name Amerrique, which is said to have been the aboriginal name of a tribe of Indians living in Nicaragua and there found by Christopher Columbus. The whole question was very exhaustively discussed by the late Jules Marcou, who was a strong opponent of the claims of Vespucci, and had at the time of his death just completed a fresh paper on the subject, which, it is to be hoped, will see the light. Fortunately and appropriately at the present juncture the explorer's register of baptism has just been discovered in the Church of San Giovanni at Florence. It reads: "*Lunedi a di* 18 *Mars* 1452, *Amerigho et Matteo, di Messere Nastagio, di Messere Amerigho Vespucci, popolo Se Lucia Ognissanti.*" Besides the date, there follow from this two facts of some importance: first, that the future explorer had a twin brother; secondly, that he was christened Amerigo, a form of name not so much unlike America.

Vespucci's father was a notary in Florence, and the young Amerigo became a clerk in the great merchant house of the Medici,

by whom he was sent to Spain about 1490, and was employed in the fitting out of both the second and the third expeditions of Columbus. Vespucci's claim to be the discoverer of America rests chiefly upon his own word, since, as we have seen, the evidence of his name alone is not very convincing. He said that he went on an expedition which left Cadiz about May 10th, 1497, and after stopping at the Canary Islands came "at the end of twenty-seven days upon a coast which we thought to be that of a continent." Unfortunately, contemporary history is silent regarding this voyage, and it has been proved that from the middle of May, 1497, for the next twelve months Vespucci was busily engaged at Seville and San Lucar in fitting out the fleet with which Columbus sailed on his third voyage. Vespucci, of course, did go to America with three subsequent expeditions, concerning each of which he wrote a narrative. It is said that the name America was first proposed for the Western Continent by Martin Waldseemüller in his "Introduction to Cosmography," published in 1507. In a MS. map of Henricus Glareanus, dating from 1510, the legend Terra America is placed against South America.

It is another remarkable coincidence that on February 3rd of the present year a portrait of Amerigo Vespucci was discovered in Florence, forming part of an altar-piece by Domenico Ghirlandajo in the Ognissanti Church. A reproduction of this portrait, with an admirable account, was given in the *Scientific American* for March 19th. The existence of this picture was well known to Vasari, Bocchi, and their contemporaries. The Vespucci Chapel, however, was white-washed in 1616, and the painting, which was a fresco, was thus hidden. Search has been made for it before, but in vain, for two reasons: first, that there were two Vespucci Chapels in the church, and the one of them in which the fresco has at last been found passed to another family in 1616; secondly, because Vasari described the work as being over an arch, whereas it really is under an arch. It was eventually found to be in the Chapel of St Elizabeth, Queen of Portugal, behind Matteo Rosselli's canvas of the saint. The *lunette* of the altar-piece represents a standing figure of the Virgin, the broad folds of whose mantle, supported by angels, surround the members of the Vespucci family. Six women kneel on her left and six men on her right. Kneeling next the Virgin is the figure of a young man, who presents a three-quarter face view, and this is the head identified as that of Amerigo Vespucci. He must then have been about twenty years of age.

Deschnev

In 1648 the Cossack Deschnev sailed from Kolyma past the north-east point of Asia down to the mouth of the river Anadyr on the

Asiatic shore of the Pacific, thus being, it is supposed, the first European to sail down the straits afterwards named after Bering, and to prove not merely the possibility of a north-east passage, but the more important fact of the separation of Eurasia from America. For many years the exploit of Deschnev was unknown to the Russian authorities. Thus in an atlas of Siberia by Remesov, completed in 1701, a cape east of the new Siberian Islands is found to have written over it the words "Okamvassbaere Cape," an inscription that was probably added by one of the Dutch councillors of Peter the Great, on the arrival of the map at Moscow. Now we learn that not only is a statue to be erected to Deschnev at Chabarowsk on the Amur, but that the name of the East Cape is to be changed into Cape Deschnev. The latter proposal will probably meet with less cordial acceptance than the former.

Vasco da Gama[1]

It was Bartolomeu Dias who first doubled the Cape of Good Hope, but it was Vasco da Gama who first made use of the knowledge thus gained to sail from Portugal round Africa to India. This was just 400 years ago. Dom Emanuel was then King of Portugal; he was twenty-eight years old, burning with ambition and with the desire of extending his power by geographical discoveries, as had his predecessors. He conceived the great idea of conquering India, and, in the face of opposite advice from his Council, he set about it.

Four ships, the largest of 120 tons, the smallest of less than 100, were fitted out under the superintendence of Bartolomeu Dias, and set sail from Lisbon in the beginning of July 1497. The commander-in-chief was Vasco da Gama, whose flagship was the 'San Gabriel.' His elder brother, Paolo da Gama, commanded the 'San Rafael'; on the 'Berrio' was Nicolas Coelho, while the fourth ship carried provisions.

Vasco da Gama was not an ideal explorer, and at St Helena Bay, between 32° 30′ and 30° S., where the first landing was made, he came to blows with the natives, an occurrence of which his hot and violent temper caused frequent repetitions. The Cape of Good Hope was passed without difficulty, but on the 13th of December the expedition met with a severe gale, during which mutiny broke out among the crew, who wished to force the commanders of the ships to return. Vasco da Gama, however, suppressed this with great firmness, declaring that nothing would induce him to return

[1] For much of our information we are indebted to the interesting account of Portuguese discovery contained in Baron Nordenskiöld's magnificent work, "Periplus," Stockholm, 1897.

homewards before he had procured information concerning the route to India, to obtain which he had been sent out by the king.

On Christmas day a coast was seen, and for that reason the land was called Natal, the name which it still bears.

On January 6th, the expedition landed at the mouth of a river which was called Rio do Cobre. Here Coelho's ship was discarded and burned, while the others were repaired, for they had suffered much from the long voyage and heavy gales. Here, too, the mutineers obtained their liberty on the condition that they resumed their chains when presented to the king on their return home, not with any intention of harming them, but to the greater honour and glory of Vasco da Gama. This country was inhabited by Kaffirs, a race previously unknown to the Portuguese, whom they received so favourably that the country was called Terra da Boa Gente.

On January 22nd another large river was reached, on the banks of which was a richer and more cultured people than had hitherto been met with on the coast of Africa. Among them were some supposed to be a cross between Negroes and Moors; some of them even understood Arabic, and were richly dressed. The country was Mozambique, and Gama named the river Rio dos Boos Signaes. Notwithstanding this augury, a bad epidemic of scurvy broke out among the crew, this being one of the first occurrences of that disease of which we have any record.

Mozambique was reached on March 1st, Mombasa on the 7th of April, Melinda on the 15th. Thence Gama started on the 24th of April straight for India, under the guidance of an Indian pilot, whose name was Malemo Canaca, and whom Gama had procured from the ruler of Melinda through fraud and violence. It was on the 20th of May 1498, that Vasco da Gama anchored in Calicut, then an important city on the west coast of the Indian Peninsula, situated in 11° 15′ N. and 75° 45′ E. He stayed in India till the 5th of October, when he sailed westwards from Anchediva. The crossing to Africa, in consequence of contrary winds and calm, took three months, during which a fresh attack of scurvy carried off thirty men. It was not till the 20th of March that the Cape of Good Hope was rounded again, and not till the end of August or beginning of September 1499, that what remained of the expedition again anchored in the harbour of Lisbon.

It is impossible to forget that the career of Vasco da Gama was tarnished by a series of outrages which from the very first completely undermined the dominion which the Portuguese founded in India. Nevertheless, in its relations to the world at large, the achievement was one scarcely inferior to the slightly prior discovery of the New World. It forms an absolute turning-point in the commercial, economic, and political history of Africa and Asia. It is

not to be wondered at that the event has just been enthusiastically celebrated at Lisbon from May 17-20, an exhibition being held there, to which charts and plans were sent from our own India Office. Considering, indeed, that our own country has proved the largest heir of Vasco da Gama's benefits, it was natural that a meeting should be held at the India Office, and that a special meeting, attended by H.R.H. the Prince of Wales, was held in the rooms of the Royal Geographical Society on May 16th. The Hakluyt Society, too, has signalised the occasion by publishing a translation, from the pen of Mr E. G. Ravenstein, of the 'roteiro' or log of the famous voyage which we have just described.

That voyage did not in itself effect any extension of our knowledge of the geography of India other than a more exact determination of the distance between Africa and India, and an improved charting of a short stretch of the west coast of the peninsula. But the enthusiasm with which Vasco da Gama's achievement was hailed in Portugal had for long an immense influence on the development of commerce and navigation. Not merely single vessels, but whole fleets, fully manned, were despatched to India by the route that Gama had opened, in order to make conquests there, and to procure strongholds on the coast, to force the natives into treaties of tribute and commerce, and, if possible, to abolish the Indo-Egyptian and the Indo-European trade. As a result, the wave of Portuguese exploration and geographical discovery passed rapidly through the Indian Ocean to Ceylon, the Sunda Islands, and Malacca; to Socotra and Ormuz, and thence to the interior of the Red Sea and Persian Gulf; and again, from Malacca to the Moluccas, China, and Japan. Among the chief conquerors and explorers we may recall the well-known names of Tristão da Cunha, Affonso D'Albuquerque, João de Castro, and Ferdinand Magellan; and not less immortal is the name of Camoens, who sang the story of his country's deeds while banished to the distant gardens of Macao.

II

Some Recent Progress in Root-Physiology

IN the early years of the present century some of the more fundamental questions in the life of the root were for the first time recognised and studied. Through the long tale of years which have since followed, these questions have never been lost sight of; and now, when we have entered upon the last decade of the century, the same problems are being attacked with unabated vigour. As the facts are slowly gathered in, we view the problems with greater clearness, and ask the questions in new and more philosophical forms. Without unduly extending this article with a full account of all the changes and advances which have taken place during the last few years, some of the more recent and more important additions to root-physiology may be briefly examined.

As is familiar to everyone, a root growing under equable conditions of moisture and the like will extend itself vertically downwards. If it be displaced from its normal position it will slowly curve round until its tip once more regains the vertical. This effect is due, on the one hand, to the force of gravity acting as a stimulus, and, on the other hand, to the inherent property of the living tissues of the root, by virtue of which they respond to such outward influences. The peculiar property of living tissues which enables them to respond to external influences or stimuli, is spoken of as their irritability, and the directive action of gravity upon the growth of plant-organs becomes effectual through that special form of irritability which is called geotropism.

In the action of any stimulus on a living organ of a plant, two events must be clearly distinguished: the perception of the stimulus, and the reaction to the stimulus. Between these two stages of the phenomenon a third may or may not be interpolated, viz., the conduction of the stimulus. In the animal body we have precisely the same series of events. A certain influence, such as a prick, a cut, or a burn agitates the end-organs of the sensory nerves lying in the skin of one's finger. The reaction, viz., the consciousness of pain, takes place in the brain, which is widely removed from the point of perception. Between the two events we have the conduction of the disturbance along the fibres of the nerves which connect the one organ with the other.

Turning once more to plant roots, it will be seen that it is an interesting question to determine whether or no the perception

of gravity and the reaction which it evokes take place in precisely the same part of the organ. Is the perception of gravity spread over the entire growing (and at the same time potentially curving) region of the root, or is it limited to any particular spot?

The first light which was cast upon this subject was due to the observations of Ciesielski. He noticed, that when he removed the tips of the roots of certain seedlings, they never curved from the horizontal to the vertical position as did the unmutilated organs. As soon, however, as the tip had become regenerated, the normal geotropic activity was once more plainly visible. The root-tip, Ciesielski therefore concluded, was an important and necessary factor in bringing about the geotropic curvature. Charles Darwin[1] took up these experiments where Ciesielski had left them in 1872, and greatly extended and elaborated them. The important conclusion to which they led him was, that the root-apex is the point at which the geotropic stimulation is first received, whilst the zone of growth which lies just behind the apex is the region which carries out the reaction.

These experiments and views were much criticised, and led to numerous discussions. Some of the leading vegetable physiologists, and among them Sachs, altogether rejected Darwin's interpretation. In his "Lectures on Plant Physiology" Sachs writes, "In such experiments with roots not only is great precaution necessary, but also the experience of years and an extensive knowledge of vegetable physiology, to avoid falling into errors, as did Charles Darwin and his son Francis, who, on the basis of experiments which were unskilfully made and improperly explained, came to the conclusion, as wonderful as it was sensational, that the growing-point of the root, like the brain of an animal, dominates the various movements in the root." It must be admitted that these adverse criticisms were entirely justified, since the experimental proofs which were offered by Ciesielski and Darwin were far from conclusive.

So serious an operation as the 'decapitation' of the root might well be supposed to lead to changes in the irritability of the organ. The recent work of Rothert upon Heliotropism (1894) has taught us that removal of the apex of the cotyledon in certain Gramineae temporarily (1-2 days) paralyses their perceptive powers for light, notwithstanding the fact that the sub-apical parts of the cotyledon are also sensitive to light in the unwounded plant. Facts of this nature show us that there were good grounds for those who raised objections to Darwin's conclusions.

Matters remained in this highly unsatisfactory condition until quite lately, when Dr F. Czapek undertook a comprehensive series of researches on geotropism. The first-fruits of the work were com-

[1] Ch. Darwin "The Power of Movement in Plants" 1880.

municated, both in Germany and England, by Professor Pfeffer (10 & 11), in whose laboratory and under whose guidance the researches had been carried on. All who were present at the Oxford meeting of the British Association in 1894 will remember with what eagerness Professor Pfeffer's spirited address was listened to.

The plan which was adopted in this research was as ingenious as it was simple. The end of the root to be experimented on was directed into a small glass tube of suitable calibre, which had been bent on itself at right angles. The apex of the root was thus obtained at right angles to the part which carries out the curvature. Accordingly, if the apex is placed vertically the growing (and curving) part is horizontal and *vice versa;* we have, thus, a means to hand by which we can determine whether it is the 'tip' of the root or the growing region lying behind the apex which is perceptive of the stimulation due to gravity. Two batches of roots, which had been treated in this way but which were otherwise normal, were taken. The members of the one batch were placed so that their apices were vertical, whilst those of the other group were arranged so that the growing region was vertical. The result was that the first set with vertical root-tips grew downwards without exhibiting any curvature, whilst those plants which had their root-apices horizontal, curved in the growing region, so as to bring the apices into the vertical position which is normal to them, notwithstanding the fact that the growing region was itself displaced from the vertical by this movement. The long disputed question was at length set at rest by these experiments and it can no longer be doubted that Darwin's views were correct. The apex of the root receives the stimulation of gravity and transmits it to the growing region behind, which reacts to the stimulus by a curvature. The enthusiasm with which Professor Pfeffer's communication was received at Oxford was perhaps not altogether uninfluenced by a feeling of pleasure that our great naturalist had been in the right through these long years of controversy.

In the following year Czapek (1) published his "Untersuchungen über Geotropism" in which the above-mentioned matters were set down at length, together with many other results of importance. The demonstration that the perception by the root-apex of the stimulus due to gravity was influenced by the various conditions of environment otherwise than was the reaction itself, is of great interest. Under a temperature too low for the geotropic curvature (reaction) to take place, the perception of the stimulus by the root-tip was nevertheless manifest. The curvature of the root, which is the end result of the stimulation of gravity, is directly dependent upon the growth of the organ. Stop the growth of the root and you at the same time stop the reaction.

The experiments of Köppen have shown that in the case of *Lupinus albus* the radicle ceases to grow at a temperature below 7·5° C., and Czapek himself found that at temperatures between 0° and 2° C. growth was inhibited in all the plants he used for these experiments. If, therefore, radicles of *Lupinus* and *Faba* were laid horizontally, at temperatures not higher than 2° C., the geotropic curvature was not carried out even after twenty-four hours induction. At the end of this time the still straight roots were placed on a clinostat (an instrument on which gravity is made to act equally in all directions, and on which, therefore, that force is practically eliminated as a stimulating agent) at a temperature of about 19° C., and in from four to five hours geotropic curvatures were clearly visible. In these radicles the perception of the stimulus (gravity) had taken place at the low temperature, although the reaction itself could not be accomplished under the circumstances; for as soon as the temperature was raised, and the conditions rendered suitable for growth, the rootlets carried out a curvature which could only be in response to gravity acting during their stay in the cold, since in the second and warmer stage of the experiment the stimulating action of the force had been eliminated. Although the perception of the stimulus is not entirely inhibited by a low temperature it is none the less affected by it. The lengthened time for which the force of gravity must act to evoke its result, shows that the perceptive faculty of the living cells of the root-apex is lowered by the lowness of temperature.

Another condition of environment which was carefully studied was that of an atmosphere containing no oxygen. The work of Kraus, Wortmann, and Correns was the first to give us any information regarding the effect of absence of oxygen upon geotropic phenomena. These experiments, however, left much still undecided and many points calling for a more extended examination. The time during which these botanists subjected the plant-organs to geotropic induction was not, in any case, sufficiently long to decide with certainty that the stimulation was not felt in the absence of oxygen. A longer period spent in an oxygen-free atmosphere, however, directly affects the life of the root, so that there were great difficulties in the way of obtaining conclusive evidence.

The ingenious application of Chudjakow's results by Czapek enabled the latter to overcome the difficulties which had invalidated the work of previous experimenters. Chudjakow, in carrying on his researches on the intra-molecular respiration of vegetable organs, had found as a side-result that the higher the temperature the more rapidly did the organ die in an atmosphere containing no oxygen. It occurred to Czapek to see, therefore, whether a root placed in a vacuum could not resist its usually harmful effect when the tem-

perature was kept very low. Roots left for twenty-four hours in a vacuum at a temperature of 0° to 1° C. were quite healthy at the end of that time. On being placed once more in air at the ordinary temperature of the room, they resumed growth, and showed all the properties which are normal to these organs. In the actual experiments on geotropism, roots of *Lupinus* were placed horizontally for twenty-four hours in an atmosphere free from oxygen, and at a temperature of 0° to 2° C. During the whole of this time growth was entirely arrested in the organs, and no reaction could therefore be manifested by them. The roots were then placed on the clinostat, at the temperature of the room and in ordinary air. In a few hours geotropic curvatures were clearly shown.

From these results of Czapek and of the older workers it will be seen that, whilst the absence of oxygen inhibits the growth of the roots and prevents the display of a reaction, it does not arrest the perception of the stimulus by the root-apex. The previous work of Wortmann, Correns, and others had already shown that want of oxygen stopped the growth, even at ordinary temperatures, whilst the experiments of Czapek have now indicated that the perceptive faculty of the root is not prevented by the absence of this gas. As in the case of low temperatures, so also here the perception of and reaction to the stimulus are governed by different laws.

The effect of mechanical prevention of growth in geotropic organs was also examined by Czapek, but, beyond mentioning that in these cases the perception of the stimulus was not arrested at the same time, we cannot offer any comments in the present paper.

When a root which normally grows straight downwards is displaced from that position, its growing part bends round until the apex is once more in the vertical. A question which naturally rises to the mind in connection with this is, in what position is the reaction at its maximum? Sachs, partly on experimental and partly on theoretical grounds, believed that the horizontal position was the one in which geotropic reactions were most marked. As the root was displaced more and more from the vertical, the reaction became more and more vigorous, until when the horizontal direction was attained the highest point was reached; as the root was displaced above the horizontal the reaction gradually became less, until it completely died away when 180° had been passed through.

Czapek investigated this question both by studying the magnitude of the after-effect following inductions of equal length when the roots were placed at different angles from the vertical, and also by measuring the time-relations of the reaction. He found that the horizontal was not the position of maximum reaction, but that this was some 45° above the horizontal. From this point onwards, until the roots were once more vertical but in the reverse direction to the

normal, the vigour of the reaction became less and less, but still remained higher than at 90°. When the tip of the root is exactly upside down, that is to say when it points accurately vertically upwards, it is theoretically once more in a position of equilibrium, and the geotropic reaction should equal 0. As a matter of fact the root curves round until the tip is once again directed vertically downwards. Sachs had already explained this as an effect of nutation, which carried the root out of the exactly upright position and so brought it under the influence of gravity again, and the experiments of Czapek tend to bear out this view.

The latter part of Czapek's work is occupied with an interesting account of 'autotropism,' and the elimination of geotropic curvatures by virtue of autotropism. By autotropism is implied the inherent tendency of vegetable organs to grow in a straight line unless they be compelled by outward influences (gravity, light, etc.) to bend aside from that direction. Moreover, having bent aside to the action of a transient external stimulus they subsequently straighten themselves out again through the agency of the same inherent quality. The reader, however, must refer to the original for these matters.

Up to this point we have only referred to phenomena presented by the main root. Both in the paper already mentioned and in other special ones Czapek (2 & 3) has studied the geotropism of side-roots. These apparently are governed by somewhat different laws; they do not grow vertically downwards like the tap-root, but occupy a position in which they form a greater or less angle with the vertical. Dealing with side-roots of the first order, Sachs was inclined to attribute their oblique position to a weaker geotropism residing in them. The angle they form with the vertical he called 'the angle of geotropic limitation.' In turning his attention to this subject Dr Czapek first satisfied himself that the only external force inducing the oblique position was gravity. Having settled this point by clinostat experiments, he next enquired whether the oblique position of the rootlets could be explained in the manner indicated by Sachs, viz., by a limited action of gravity, or whether a different explanation was needed. A number of plantlets of *Vicia Faba* were taken and divided into two groups. In the first group the side-roots were turned 60° above their normal position, whilst in the other set the rootlets were placed 60° below their usual direction. The experiment, which was carried on in darkness, showed that the rootlets of the first group returned to their normal position more rapidly than those of the second batch. The intensity with which side-roots, placed above their usual position, bend is therefore greater than that manifested by rootlets displaced below the normal direction. Czapek believes that these facts point to a two-fold geotropic action: to a positive geotropism common to the side and the main roots alike,

and to a transverse geotropism which tends to give the organs a horizontal direction. In the case of the roots which are turned above their 'angle of geotropic limitation' the horizontal and positive geotropisms act together, whilst in the opposite case in which the displacement is below the normal angle the transverse geotropism acts in direct opposition to the positive geotropism. In this way Czapek seeks to explain the oblique position of the rootlets and the other phenomena which were noticed in his experiments. What Sachs called the 'angle of geotropic limitation' is on this view the resultant of the action of two forces—positive geotropism and transverse geotropism.

In the same memoir Czapek includes his important work on the directive forces acting on rhizomes and underground stems.

Quite lately further interesting observations on the behaviour of side-roots have been published by Alfred Schober (13). He ranges his experiments in two series, according as the main root is compelled by growth to bend on itself at an angle and thus bring the normally oblique side-roots into a vertical position, or as the main root is merely placed in a slanting position sufficient to bring the rootlets into the vertical. The experiments were carried on in one of Sachs' cases with a glass side, and the seedlings were so arranged that their side-roots lay against the glass. They could be watched in every phase of their growth and all changes faithfully recorded on tracing paper. The plants used for these observations were *Pisum sativum*, *Phaseolus multiflorus*, *Cucurbita Pepo*, and *Vicia Faba*. It was found that when the rootlets were placed in a vertical position they lingered for a shorter or longer time in this direction, and then usually bent aside so as to bring their apices into an oblique position. In nearly every instance the curvature took place in a plane passing through the side and the main root. In a few cases, as for instance in one recorded for *Cucurbita Pepo*, the rootlet when placed in the vertical line continued to grow in this direction throughout the twelve days that the observation was kept up. This behaviour is, however, rare, and only serves as the exception which proves the rule. It was noticeable that, although the curvature of the side-roots from the vertical nearly always took place, they seldom bent sufficiently to attain their normal 'angle of geotropic limitation.' The lingering, too, in the vertical was also sometimes very noticeable; Schober mentions the cases of *Cucurbita* and *Vicia Faba*, in which the rootlets continued to grow for 2 cm. in a straight line before they manifested the characteristic curvatures.

These experiments bring out another interesting point, viz., that the direction of the curvature is partly fixed and partly irregular. It may be said, in general terms, that the rootlets springing from the hypocotyl (the part of the stem below the seed-leaves) and from

the adjoining base of the root curve upwards towards the shoot part of the plant—as Czapek expresses it; whilst the side-roots arising nearer the root-apex are indefinite, and may bend towards the shoot or towards the main root. In one and the same individual rootlets may be seen bending in both directions.

Another manifestation of irritability by roots has lately received renewed attention from Professor Spalding (14). In his work on the "Power of Movement in Plants," Charles Darwin first examined the effect of attaching small pieces of cardboard and the like to the tip of the root by means of shellac or gum-water, or of touching this region of the organ with dry silver nitrate (caustic), or of slicing off a small fragment from one side of the apex. The usual result was that the root executed a curvature, in the growing region, of such a nature that the convexity was on the side of the object or cut. Darwin concluded that the phenomenon was one of irritability and that the apex was sensitive to the stimulation of touch. These experiments of Darwin led to a long discussion, which, although fruitful in many respects, yet left the main issues undecided. It was clearly shown by Wiesner that the curvature was due, not to simple contact, but to injury. Detlefsen believed, on the grounds of his researches, that these curvatures—often called 'Darwin's curvatures'—had no connection with the irritability of the organ but were purely mechanical results of the injury. Wiesner, likewise, favours a mechanical interpretation, but many of his experiments and statements may equally well be taken as upholding the opposite view, which invokes the aid of protoplasmic irritability. Pfeffer, on the other hand, regards mechanical explanations as insufficient, and he suggests the name of 'Traumatropism' for the phenomena resulting from such one-sided injuries. By this term he brings the processes in question in line with the manifestations of geotropism and heliotropism.

In 1894 Spalding carried out a careful research on these traumatropic curvatures, and justified the name by bringing forward good evidence for the belief that the phenomena were due to irritability. Most of his experiments were made by branding the root-apex with a small, heated, glass rod. A root so treated executes a curvature in the growing region, with the convexity towards the injured spot, and also exhibits a second bend directly over the damaged region but in the opposite direction to the first curve. Darwin had, likewise, observed this second bend and rightly—as Spalding points out—attributed it to mechanical actions. Root-tips touched on one side with silver nitrate or metallic copper behaved in a similar manner.

Detlefsen connected his mechanical interpretation of Darwin's curvatures with the altered tension of the root-cap. In fact the root-cap was, to his mind, alone responsible for the phenomenon.

Spalding shows that injury to the aerial roots of *Anthurium*, etc., although they are destitute of root-cap, still induces strong manifestation of traumatropic curvatures. Moreover, roots in which the injury is to the root-cap alone, without at the same time affecting the apical meristem or actual growing-point, do not carry out traumatropic bendings. The whole evidence, in fact, points to the growing-point as the only region sensitive to cuts, burns, or other injuries, and suggests that these agencies act as true stimuli which are conveyed to the elongating region lying behind.

These results show a close correspondence with those already mentioned in the case of geotropism, and in yet another respect do we find a similarity between the two phenomena. The latent period, viz., the time between the perception of the stimulus and the resulting reaction, can be greatly extended both in geotropism (as we have seen) and in traumatropism. A seedling of *Lupinus albus*, for example, had its root-tip branded with a heated glass rod. The rootlet was immediately afterwards confined in a plaster cast, so that its growth, and therefore also its reaction, were prevented. After eight days the cast was removed, and the root allowed to resume its growth. It at once executed a traumatropic curvature, which could only have been in response to the injury received from the hot glass more than a week before. This shows that in the case of stimulation by uni-lateral injuries the latent period can be even more protracted than in geotropic actions.

Quite a different aspect of root-physiology has been touched upon by Czapek (4) in his paper "Zur Lehre von den Wurzelausscheidungen." In this paper the substances which are excreted by the root into the surrounding medium are subjected to a careful and searching examination. In the present article it is impossible to enter at any length into the numerous important facts and conclusions which Czapek has set down in the memoir quoted, we can only pick out one or two significant points, and shortly deal with these.

The older teachings of Liebig and others, that, in the excretions of the root, substances are present which alone are capable of laying open to the plant the nutritive store of the soil, has, with the course of time, been modified gradually, and taken with ever increasing reserve. The fact that roots excreted acids, capable of permanently reddening litmus-paper and of corroding a smooth surface of marble, had, however, been long believed in by botanists. The researches of Czapek have now thrown considerable doubt upon this point. In no instance could he satisfy himself that any of the stronger acids passed out from the root in the free state. Acid salts and carbonic acid could alone be detected, and all the phenomena upon which the idea of free acids in the excreta depend, can certainly (as Czapek points out) be explained by the presence of these two substances.

The most important of the acid salts is the mono-potassium phosphate, and this is quite capable of permanently reddening litmus-paper. The other pillar which upholds the view of an excretion of free acids by the root is the fact, first indicated by Liebig and Sachs, that when roots are grown on a polished slab of marble they eat this away in their progress, and mark it out in curious corrosion-figures. By using artificial slabs of known composition (*e.g.*, calcium carbonate, calcium phosphate, aluminium phosphate), Czapek has been able to bring forward very strong evidence that carbonic acid is the only acid responsible for the corrosion-figures. Substances not dissolved by carbonic acid are likewise unaffected by the excreta of the root.

Whilst accepting these results so far as they go, Pfeffer (12) points out that the question can only be regarded as determined for the particular plants investigated, and for the particular conditions under which the observations were carried out. The fact that we are acquainted with certain fungi which excrete organic acids, and that this formation of free acid is largely dependent on outward circumstances, speaks in favour of this view. "We should not be surprised," Pfeffer remarks, "if certain flowering plants were yet discovered which made use of the undissolved ash-constituents by means of an energetic secretion of acids."

Of the other substances present in the excretions of the root, the most interesting, perhaps, is formic acid, which had previously been detected by Goebel (5). This acid, Czapek believes, does not occur in the free state, but in combination with potassium. The acetic acid which Becquerel believed he had found in root-excreta could in no case be seen, either free or combined, by Czapek, neither could Boussingault's lactic acid. Oxalic acid, although not generally found, could be clearly demonstrated in one instance, viz., *Hyacinthus orientalis*. Enzymes were not found with any regularity in the excretions of the root, and in this respect Czapek's results differ from those of Molisch (7).

The excretion of the root is generally supposed to pass solely through the root-hairs. Czapek points out that this conclusion is based upon insufficient grounds, and that we even have evidence against it. Roots of hyacinth grown in water are without hairs, and yet excrete oxalates; the formic acid is given out by the youngest parts of the root below the region of the root-hairs.

Another interesting contribution to root-physiology is that of George Peirce (8) on the penetration of roots into living tissues. Pfeffer (9) in a previous research had shown that the roots of the different plants he examined exerted a considerable pressure in their growth. Thus, in one case (*Vicia Faba*), a longitudinal pressure of 7-10 atmospheres was found to be attained by the growing root. These observations suggested the idea that the

roots of various earth-inhabiting plants might be induced to penetrate living vegetable tissues. Peirce, in examining the matter, took potato-tubers and split them in half. In small slits on the one half he inserted seeds of *Brassica napus* or *Sinapis alba*, and then tightly bound the two parts of the tuber together again. He left these manipulated potatoes for twelve days in moist sawdust and then unbound them. He found that nearly all the seeds had germinated, and that whilst a few had grown along the line of the cut in the tuber, others had penetrated the substance of the potato. In some cases growth had been so vigorous, that not only had the parenchyma of the half-tuber been penetrated, but the root had actually made its way through the cork-layer on the outside and grown into the sawdust. Other experiments, rather differently arranged, showed that *Pisum* and *Vicia Faba* could likewise penetrate living tissues. Not only did the roots of these plants grow into tubers of potato but also into the stem of *Impatiens sultani*, leaves of *Echivaria*, *Aloe* and other plants. One of the most interesting and significant results which Peirce obtained was to grow specimens of *Pisum* as parasites upon other plants from the seedling stage until flowering. *Impatiens sultani* formed the most satisfactory host. In *Pisum*-plants grown under these peculiar conditions the root-system was formed in a fairly normal manner, although the rootlets were destitute of hairs; the stem, however, was stunted, but bore leaves and a few flowers. The importance of this experiment to the student of parasitism will at once be evident.

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III

The Study of Variations: A Rejoinder

PROFESSOR HENSLOW has apparently completely misunderstood my paper in this Magazine for April. My object was, leaving the whole question of facts and observations out of consideration, merely to point out some reasons for the well-known difference of opinion on this subject among present-day biologists.

In referring to Professor Henslow's theory I endeavoured to show that another explanation, quite as plausible and equally in accordance with the facts adduced by himself, could be advanced. Thus there would be two theories in the field, both explaining the facts, and neither absolutely negatived or directly supported by these facts. Consequently, to test the merits of the rival theories a fresh series of data would be required. The ultimate decision might be in favour of Professor Henslow and the Lamarckians, and opposed to the Darwinians, or *vice versâ*, or might show that both theories were partially correct. I did not doubt the facts, or even assert that the conclusions drawn were incorrect, but argued that this possibility of double interpretation proved the conclusions to be inadequately supported. Professor Henslow says he does "not quite see, if the conclusions be correct, how the argument can be faulty." This statement must surely be due to an oversight, for it is notorious that right conclusions may accidentally be arrived at through fallacious arguments. But I did not suggest that his conclusions were either correct or incorrect; my position is, that in either case the facts on which they are founded would equally support other conclusions.

On page 313, paragraphs 1, 3, 4, 5; and again on page 314, paragraph 1; and page 315, paragraphs 3 and 4, he makes a series of statements in reference to the Neo-Lamarckian position, which position he considers I have misunderstood. (1) ". . . The purport of Neo-Lamarckism is precisely that embodied in the words of Darwin quoted, or the discovery of 'the primary cause of modification.'" (2) "Neo-Lamarckism is only concerned with tracing out the causes which originate or bring about the variations themselves." (3) "'No selection except from general strength.' In this last [kind of variation] I seem to recognise my own position."

I find it difficult to reconcile these three statements. The meaning of the first position appears quite plain, 'the primary cause

of modifications' being the sole quest of the Neo-Lamarckians. If this is so, they are working on a part of evolution which Darwin confessedly found difficult to elucidate, but which can yield nothing opposed to his views. Indeed, as Mr Henslow himself has insisted by means of an admirable quotation from Darwin, ". . . Natural Selection . . . has no relation whatever to the primary cause[1] of any modification of structure." It follows that there can be no antagonism between two positions so distinct. In fact, the Neo-Lamarckian is included in the other larger, Darwinian position.

But the second definition involves something more than a study of the primary causes of modification, since causes which bring about, as well as those which originate, variations are here included. In the third position Mr Henslow accepts for himself the views which I formerly ascribed to him, and eliminates natural selection as a species-forming, though admitting it as a possible species-separating, force. Which of the three positions he would have us accept, it is hard to infer, either from his reply or from his works.

He further says: "There is no necessity for all the individuals to be equally, though they be all similarly, modified. Natural Selection need not enter so timidly as he imagines, but may boldly kill off as many as it pleases, and thus 'become a factor of some importance'; but this has nothing whatever to do with the primary cause of the origination of the definite variations. These being now known, it is at once seen that Natural Selection plays no part at all in causing them." Mr Henslow here seems to hold that variations, when occurring in any given variety, may vary in degree, but that this degree will remain constant in each; that, given a certain number of variations from a certain point, each one of these will continue to vary at the same rate whether other variations are present or not; and, consequently, that "Natural Selection thus applied only separates varieties and makes them more distinct for the benefit of the classifier," but plays no part directly or indirectly in forming these divergences; it only eliminates the unsuccessful intermediate varieties when formed.

Now the objection that I raised to this position was, that as there are at least as many eminent authorities who hold opposite views and are not convinced by the facts adduced in support of this contention, it is not enough to assert that it is so; it must further be shown that where Natural Selection is not able to act, varieties have diverged and adapted themselves as rapidly as similar varieties have in a control experiment, in which Natural Selection has been given full opportunity of acting. Again, when I questioned the validity of assuming that definite variations are necessarily opposed to Natural Selection, he, in reply, mentions what I already knew, that

[1] Spaced type mine.

Romanes regarded indiscriminate variations as essential to the theory of Natural Selection. Had Romanes and other biologists thought otherwise, it would have been unnecessary to raise this point, and it was only because I had not seen my position taken up elsewhere that I put it forward.

Professor Henslow may be told by many that his books do prove that variations are definite, but, unfortunately, for the present state of the question there are at least an equal number who think otherwise. But were all biologists unanimous on this point my position would be unaffected, since it maintains that definite variations can be easily accounted for by Natural Selection alone. The fact that Darwin and Wallace were both unaware of this, does not invalidate the theory in the slightest degree, since they could not possibly be expected to have foreseen every development of their views. Mr Henslow finds my theory on this subject to be 'offered without a particle of fact' to support it; but no fact is here needed, the position being that a theory is offered in support of Natural Selection, leading naturally from indefinite to definite variations in the course of evolution. It is not a question of facts, as at present collected; it is simply a question of two competing theories, which would both explain the definite variations in nature, if they exist. It will therefore be only from a careful restudy of variations that we can hope for a more settled view of this question.

The difficulty that Professor Henslow finds in this to me obvious deduction astonishes me; I can see nothing complicated in the assumption that Natural Selection, as it necessarily must eliminate the unfit, will as necessarily leave behind to grow and reproduce with each other the more or less fit; and that with each succeeding generation the variations must tend to become increasingly fit, and, consequently, more or less definitely adaptive. Indeed it seems to me to be a much greater assumption to say that variations are adaptive on the present data, since a biologist's knowledge would be great indeed if, even on any given single variety, he were able to prove all its variations useful, and much more so were he able to establish the same result with reference to species.

Lastly, I am asked to give half-a-dozen examples of plants and animals living in a wild state, which I can place within the first three groups of my classification of variations. As the whole object of my paper is to point out that no instance can be adduced by any biologist which will be accepted by others holding opposite views, it seems a little extraordinary that I should be expected to give six instances, or even three or one, when I believe none are to be found in the present state of our knowledge on this question.

Weismann, in *The Contemporary Review* for September 1895, states this difficulty very clearly: "An essay by Herbert Spencer is

always interesting reading, even when one does not agree with him. He can defend his thesis admirably; and the most destructive arguments that are brought against him seem to turn, in his skilled hand, into supports for his views. I am quite convinced that it would be impossible for me to adduce any evidence on my side to which he would not have some reply to make, and so we might prolong this conflict of opinions indefinitely."

The disputes which have occurred in the last ten years are surely sufficient evidence of this unsatisfactory condition of affairs.

To recapitulate. I started with the well-known difficulty that biologists have in coming to anything like a unanimous conclusion on this subject. I then endeavoured to prove that more or less equally plausible, though conflicting, theories could be advanced to explain the facts at present collected, leaving entirely out of the article my own views on heredity, and taking up a neutral position; lastly, I pointed out that this unsatisfactory state of things might be due to a too indefinite use of various terms and too hasty generalisations, and, therefore, that more precise methods were needed. I do not see that any one of these positions has been affected.

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IV

The Migration of the Right Whale (*Balaena mysticetus*)

Part I.—In the Greenland Waters

WE are so accustomed to regard systematic migration as an attribute peculiarly distinctive of the birds of the air, and only shared with them to a limited extent by a few terrestrial animals, as to be in danger of overlooking the fact that this mysterious instinct (?) is also conspicuously developed in marine mammals. Some members of the Order Pinnipedia especially afford striking examples, but in none does it exist with greater regularity and persistency than in the Cetacea. Dr Nansen, in the "First Crossing of Greenland," remarks that "whales have evidently their migrations, though we know little or nothing about them," a reproach which this imperfect contribution to the subject is an attempt in some degree to remove. Since little has been written specially devoted to this interesting feature in their life-history, my object is to present in concise form the information on the subject, at present so widely diffused that its full significance is not apparent. So far as I know, the most important papers bearing on the migration of the Cetacea are those of Eschricht and Reinhardt[1], and Dr Robert Brown's valuable papers as reprinted with additions in the "Arctic Manual" (1875, Part 1., Biology, pp. 1 and 69). Much is to be gleaned from the voyages of the early Arctic discoverers, and something from the many less pretentious expeditions in more recent times; but too often the vague mentions of 'whales' seen leave the species so uncertain as to be valueless for any useful purpose. This is excusable when we consider how very difficult it is to identify them when seen perhaps only for a brief period, and from the deck of a vessel in perpetual motion. It thus happens that the chief and most reliable information is to be derived from those whose business it is to pursue and capture these animals in their summer haunts. Here again caution is necessary, for intelligent as some of our whalemen have been—and I need only mention Scoresby and David Gray in the Atlantic, and Scammon in the Pacific—it must be borne in mind that their main object is the

[1] "Recent Memoirs on the Cetacea," by Profs. Eschricht, Reinhardt, and Lilljeborg. Edited by W. H. Flower, pp. viii., 312, 6 plates. 4to. Ray Society, London, 1866.

capture of these valuable prizes, and not the study of their habits, except in so far as such a knowledge would conduce to that result; and tradition has a very strong hold upon them. It unfortunately happens, too, that these men, who could tell us so much and are perfectly ready to impart information, owing to their very familiarity with the subject, and perhaps to their regarding much really of scientific value as too trivial to be worthy of mention—are extremely difficult of approach, and it requires no little previous knowledge of the subject to elicit at such interviews all the information possible. Nevertheless, I have to acknowledge with gratitude the invariable kindness I have received from the whaling captains, and the value of the information resulting from many conversations and much correspondence with them extending over many years.

In so imperfect a sketch as this must of necessity be of so wide a subject, it would be impossible to deal with Cetacean Migration generally, I propose therefore on the present occasion to confine my remarks to one species, the Arctic Right Whale (*Balaena mysticetus*), an animal which has been more or less under observation ever since the first decade of the seventeenth century, when it was discovered by Henry Hudson frequenting the seas west of Spitzbergen in great numbers, and became the object of attack by men of various nationalities. At first it was hunted from the shore, but as, gradually driven from the bays and fjords, it became scarcer and more wary, its pursuers became more and more enterprising, and followed it farther and farther into the ice-fields. And here I may perhaps be allowed once for all to dispose of the popular idea, so oft repeated and so difficult to eradicate, that the Greenland Right Whale formerly frequented the temperate waters of the Atlantic Ocean, and that it has been driven north by persecution, or has been exterminated in the more southerly localities. The true *B. mysticetus*, greatly reduced in numbers it is true, and only an occasional visitor in some localities where once it was common, still frequents precisely the same waters in which it has ever been found, and from the nature of its habits must continue to do so, so long as it exists as a species. The whale of the genus *Balaena* formerly found in considerable numbers from the Bay of Biscay to the North Cape, according to season (for it also was a regular migrant), and still occasionally met with in the waters of the North Atlantic, is a perfectly distinct species, a fact fully established by the investigations of Eschricht and Reinhardt.

It is not my intention to follow the so-called 'Greenland' Right Whale into the Pacific, where it is also found; but the two resorts with which I propose to deal are the northern extensions of the Atlantic Ocean, lying to the east and west of Greenland, reaching

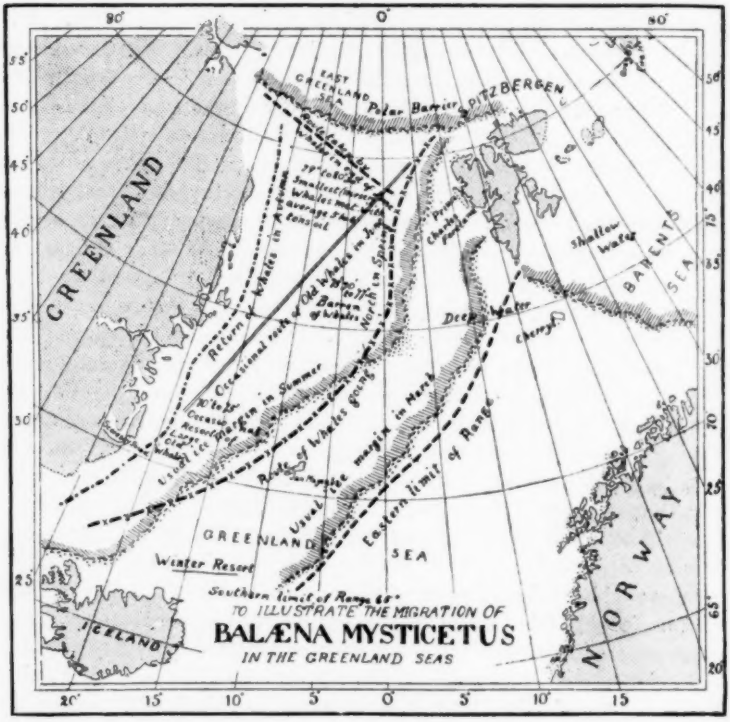
on the east side of that frozen land to the western shores of Spitzbergen, and on the other westward to the waters of the Arctic archipelago forming the much broken extension of British North America, and comprising Davis Strait, Baffin Bay and the many straits and sounds lying still further west, but to what precise extent is not fully known. On the east side of Greenland, *Balaena mysticetus* winters in about 65° N. latitude, and has been found as far north as the barrier presented by the border of the permanent polar pack. Its range on the west side will be discussed later on, since it is intended at present to confine ourselves to the Greenland seas. In all its wanderings it rarely quits the ice-edge, and may be said to inhabit "the region of the loose ice and open water-spaces, bounded on the one side by the sea, and on the other by the edge of the solid ice, nearer by choice to the former than to the latter" (Gray).

I will now endeavour to trace the migration of the Right Whale in the Greenland seas, but first it should be explained that when migrating the behaviour of the whale differs materially from its mode of proceeding at other times. Dr R. Gray (*in lit.*) tells me that a whale 'on passage' may be readily recognised, "it goes steadily onward with considerable rapidity, with the upper jaw from the tip of the nose backward as far as the blow-holes above water, the body submerged, and, except for the eddy caused by the action of its tail, apparently motionless. It continues thus for some five or ten minutes, blowing at regular intervals all the while, then, throwing up its caudal fin it leaves the surface and before re-appearing may have performed the distance of a mile. Swerving neither to the right nor to the left, it continues its onward journey and no ordinary ice-field causes it to alter its course." Scoresby says that a "run of whales of a particular tribe passing from one place to another has been traced in a direct line from south to north, along the edge of the western ice through a space of two or three degrees of latitude, where it has entered the ice to the north-west and passed beyond the reach of the fishermen."[1] On such occasions they usually associate in small flocks or 'schools,' but have been observed in considerable numbers. Dr Brown was informed by Dr M'Bain, R.N., that a little north of Pond's Bay he saw a continuous flock of several hundreds pass north, and a few days after they were followed by a herd of walruses, the numbers of which were "beyond all computation," all seeming intent on reaching the opening to Lancaster Sound. Dr Brown pertinently asks, where could such a number of these huge animals come from?

Not much is known with regard to the sojourn of the whales in their winter quarters. As the ice becomes disrupted in the early spring they pass along to the northward, availing themselves of the

[1] "An Account of the Arctic Regions," by W. Scoresby, jun. 2 vols. Edinburgh, 1820. Vol. ii., p. 214.

open waters and floes. It might be expected that at this time they would be met with by the vessels which, in the months of March and April, search the ice-edge for the young seals, usually to be found to the north-east of Jan Mayen, between 70° and 73° N. latitude and 1° to 4° E. longitude, in accordance with the lie of the ice; but as the whales keep well within the margin of the ice they are rarely seen *en route* at that time; when seen, however, they are always passing northward. Large numbers of these 'spring



migrants' were observed by some Dutch sailors who wintered on the Island of Jan Mayen in 1633-4; they first appeared off the island on the 27th of March, and were seen almost daily in larger or smaller numbers till the end of April; the poor fellows did not survive to tell the sad tale which their diary disclosed. The next appearance of the whales is on the north-west fishing ground in about the latitude of Prince Charles' Foreland, where they are met with by the whalers in the middle of May, and continue in their summer resort till the end of June, awaiting it is presumed the breaking up of some ice-barrier which bars their further passage.

Certain it is, however, that about that time they suddenly disappear for the season in a north-westerly direction. After the middle of June, whales are generally found in about 72° to 75° N. and 13° W. longitude off the east coast of Greenland. This is known as the south fishing ground, and from here the vessels usually take their departure for home early in August; but some very large whales have been killed in the end of August and early in September, indicating the return autumn route of the whales to be along the land-water of the east coast of Greenland. The old males (not so often females) frequently remain off the coast all the summer till the return of the females and young or growing whales; they approach the shore in autumn, when they join forces and work south together to their winter quarters.

The movements of the whales frequenting the Greenland seas are subject to considerable uncertainty; the vast extent of ice with its varying and irregular distribution, the influence of prevailing winds, and the presence or absence of food-supply render it very difficult to predict the precise locality in which they will be found at any given period of any particular year. There are also many other disturbing influences, some of which are not at present well understood; but the above is, I believe, a fairly accurate outline of the usual routes and times of migration of the Right Whale in the Greenland waters. It is traced on the accompanying chart.

A few of the many interesting features with regard to the migration of the Right Whale may here be mentioned. Not only is it probable that a separation of the sexes takes place at certain seasons, but also that to some extent the individuals of various ages form themselves into separate communities and occupy stations of their own. It has been observed that the older whales, especially the males, frequent more open water than the females and growing whales, the latter preferring the vicinity of the fast and solid ice. This would account for the presence of the large whales in 70° to 75° N. already mentioned; but in former times some very large whales, known as 'blue-water' whales, used to be captured far from the ice; some of these have yielded as much as twenty-eight or thirty tons of oil, but they are now very rarely met with. The last I have heard of was taken in 1875, and its longest slip of 'bone' (baleen) measured 12 feet 6 inches. These must have been very old whales, and it is possible that they may have been deposed from their leadership, perhaps by some more vigorous members of the herd, as occasionally happens with individual sperm-whales. The assortment, as it were, of the whales, according to size or age on the various feeding grounds, is a fact well known to the whalers, and Captain Gray tells me that the largest whales are taken between 70° and 75° N.; between 75° 30′ and 77° N. the sea is usually

barren of whales; 77° to 78° 40′ N. produces 'second-sized whales' averaging from ten to twelve tons of oil; whilst from 79° to 80° 20′ N. are found only 'nursery whales,' averaging from five to ten tons of oil each. The following statistics will illustrate this:—In 1814 Captain Sutter made his celebrated capture of forty-four whales in 79° N.; they averaged only 5¾ tons each. In 1886 fourteen whales, killed by two vessels fishing together in the same latitude, averaged the same. In 1884 Gray killed four whales in 77° 30′ N., which averaged thirteen tons each; and the same year three whales in 73° N., which averaged seventeen tons of oil. In 1863, also in 73° N., he killed eight whales which averaged 16½ tons of oil. Scoresby, in about the same latitude, on the 15th August killed three whales, and a companion vessel a day or two later, a fourth; these averaged twenty tons each. Lastly, on the 21st June 1887, D. Gray, in 73° 40′ N., killed a female whale which measured 57 feet in length, and yielded twenty-seven tons of oil; the longest slip of 'bone' of this monster measured 11 feet 4 inches, and weighed when cleaned 9 lb. 5 oz. Scoresby inclines to the opinion that these three classes of whales represent distinct 'tribes,' and that they adopt separate lines of migration; the latter is undoubtedly the case, but that they differ from the other whales, except in age or sex, is unlikely. Reasoning from analogy it seems not improbable that, if the adults of both sexes form themselves into different 'schools,' individuals at other stages of growth may do the same. We know that in the case of the Eared Seals the 'bachelor' or non-breeding seals separate from the breeding portion of the community, and it may be that the adult and non-breeding Greenland whales herd in separate flocks habitually, a still further sexual division of the adult flock taking place at certain periods. Scoresby (*l.c.*, p. 292) thinks that the females and young retire into the interior of the bays and sounds in the summer, which he considers is the commencement of the period of gestation; but even this, supposing it to be the case, would not account for the disproportion of 'suckers' to young growing whales, much more conspicuous now than in his day, and especially so in the Greenland seas. Females accompanied by suckers are now rarely met with, and it follows that they must either have a secure hiding-place in which to remain until the young are able to take care of themselves, or that reproduction has for many years been greatly arrested, or has almost ceased, the young whales found in latitude 80° N. being the last of their race. The age of these whales would fairly coincide with the introduction of steam, and it may be that the old whales have since been so harried at a period when rest and seclusion are absolutely essential, that they have ceased to perform their natural functions.

There is proof that individual whales resort to the same localities year after year. Captain Gray informed me that in 1856 his men observed a whale with a distinct white mark across one side of its nose; three years later they saw it again in the same place, and struck and lost it. In 1867 he chased a whale "with a growth like a bee-hive on the left side of its tail"; in 1872 he killed this same whale, and almost on the same spot. Writing in 1886, he said that in 1880 he chased a whale with a large white splash on its back, and that he had seen it every year since. He also states that whalers come to know strongly-marked individuals, and recognise them from time to time, thus showing that the whales follow the same line of migration for many successive seasons.

From east of Spitzbergen I can glean very little information with regard to the occurrence of the Right Whale; nor, when we consider the requirements absolutely essential to its well-being—ice of great extent, and of a sufficiently open character, deep water, and an abundance of the minute organisms which are consumed in such vast quantities to nourish its mighty fabric—is it reasonable to expect that the shallow waters of Barents Sea should be largely visited by it. It is true, as pointed out by Eschricht and Reinhardt (*l.c.*, pp. 25, 26), that the ancient Dutch whalers speak of a whale which they distinguished as the 'South-ice' whale, and believed that it came from the east round the south coast of Spitzbergen; but very little seems to be known about it, and that little does not affect our present enquiry, although, as these authors remark, it ought not to be totally disregarded, whether a separate species or not. But it must be remembered that Stephen Bennett and Jonas Poole, walrus-hunters, who frequented Cherry Island from 1603 to 1609, say no word about whales being found there at that time; and seeing that it was the same Jonas Poole who in 1610 brought home the news of the great abundance of whales off the west coast of Spitzbergen, which led two years later to the establishment of the successful whale-fishery from that shore, they would hardly have remained silent had they made so important a discovery. Eschricht and Reinhardt state that "it has been proved by K. E. v. Baer[1] that the whale has not been seen near the coasts of Nova Zembla." The difficulty of determining the species of 'whales' recorded as seen by modern travellers here presents itself, and it is impossible to say with certainty to what species certain whales mentioned by Nordenskiöld[2] belonged. Speaking of the Right Whale by name, however, the last mentioned author says, "thus during our many voyages in these waters we have only seen one such whale, which happened on the 23rd June 1864, among the drift ice off the

[1] *Wiegmann's Arch. für Naturgeschichte*, vol. i., p. 168.
[2] "Voyage of the *Vega*," vol. i., p. 169.

coast of Spitzbergen in 78° N.L." which is the usual hunting-ground.

Nordenskiöld further states that fragments of the skeletons of whales, thrown up in such quantities on the shores of Spitzbergen, are not in his experience to be found on the shores of Novaya Zemlya, or on the coasts of the Kara Sea and north coast of Siberia, between the Yenisij and the Lena at which he landed. Colonel Feilden also tells me that bones of the White Whale were the only cetacean remains he saw on the shore of Novaya Zemlya, either on the Barents or the Kara Sea side of the islands. Should the Right Whale stray to the eastward, it would seem more likely that it should do so by a passage north of Spitzbergen, and the only certain records known to the writer of the remains of this species having been observed in such longitudes are the following. In 1897 Mr Arnold Pike "on the summit of the basaltic ridge, say 150 feet, which juts out from Cape Hammerfest [in one of the islands of Wiche Land, east of Spitzbergen] found old whales' bones, mostly very much decayed."[1] In the more northerly parallel of Franz Josef Land, Leigh Smith,[2] on his first visit in 1880, found portions of the skeletons of "two whales" on the shore near Eira Harbour; these, Mr W. S. Bruce of the Jackson-Harmsworth expedition tells me, are of very ancient date. With regard to the two Right Whales said to have been seen by Mr Leigh Smith passing out of Gray Bay, Mr Bruce kindly informs me, on the authority of the experienced ice-master of the 'Windward,' who was with Mr Leigh Smith in the Eira, and saw the whales in question, that they were not of the species under consideration. Mr Bruce also says that nothing was seen of Right Whales during the time the expedition remained at Cape Flora. The whalers, 'Balaena,' 'Active,' and 'Diana,' which visited Franz Josef Land in 1897, were also unsuccessful in their search. No Right Whales appear to have been seen by De Longe from the 'Jeannette.' Weyprecht, in his paper on the scientific work of the 'Tegethoff,'[3] expressly says that the only species of whale met with by them was the White Whale, "near the coast, but pretty often." Of the supposed occurrence of this species east of Spitzbergen, I have not met with a single recent instance that has borne investigation, and I doubt whether in the present day it passes in that direction beyond longitude 20° east.

The Right Whale thus appears certainly not to extend its migrations regularly to the eastward of Spitzbergen, and is probably absent altogether from the Kara Sea and the Siberian waters till we reach Cape Schelagskoi in 171° E. longitude. West of this Von

[1] *Geogr. Journ.* April, 1898, p. 368.
[2] *Proc. Roy. Geog. Soc.*, 1881, vol. iii., p. 136.
[3] *Journal Roy. Geog. Soc.*, 1875, xlv., p. 32.

Wrangel, the Russian explorer, in 1823, says they are not to be found; but passing to the eastward they become more abundant as Bering Strait is approached, and to this he attributes the increase of population he found along the shore in that direction.

We may therefore, I think, dismiss from our minds any idea of the Right Whale habitually visiting the seas to the eastward of Spitzbergen; or in the present day of any interchange or overlapping of the individuals of this species inhabiting the Greenland seas and those to the north of Bering Strait by means of a north-east passage or the reverse, whether by westward drift or voluntary migration. I shall, however, later on have something to say with regard to the probability of the Bering Strait whales visiting the Atlantic by a west-to-east migration.

The whale-fishery in the Greenland seas has, as an industry, almost reached a vanishing point, and the vast fleet of costly vessels hailing from many ports, which formerly visited these waters every summer, had in the past season of 1897 dwindled to three vessels only, from the one port of Dundee; by these only two whales, one of which was killed, were seen. The absence of whales is not absolute proof of their non-existence, but may depend on various causes, some of which at least are well known to the whalers, as I have endeavoured to explain from time to time in my annual "Notes on the Seal and Whale Fishery," published in *The Zoologist* (1884-98). Here I can only say that they depend mainly on the condition of the ice; but there is no doubt—more especially since the introduction of steam—that the race, if for a few years longer saved from absolute extinction, will owe the extension to its acquired habits of greater caution;[1] and to the expensive nature of the outfit required for its pursuit rendering the business unremunerative.

Part II.—West of Greenland

The difficulties encountered in an attempt to trace the periodic migrations of the Right Whale in the narrow seas to the west of Greenland are by no means of the same nature as those experienced when following its movements in the vastly more extensive area of the Greenland Seas proper. Not only is the field of observation more restricted, but although the pursuit of the whale in these waters is comparatively a new occupation, it has been more thoroughly and systematically worked, for, in addition to the records of the Danish factories on the west coast of Greenland, there have been voyages undertaken by men of considerable scien-

[1] In the year 1697, 188 vessels killed in that one season 1959 whales off Spitzbergen. That these too confiding animals soon forsook bay after bay of these blood-stained waters for more secure quarters is not surprising.

tific training, if not for the sole purpose of studying the habits and economy of the whales, certainly with very excellent results in that direction. Scoresby, of course, takes the leading place, but Dr Robert Brown's observations (before referred to) are of great value, and the routine of a modern whaling voyage has been admirably narrated by Captain (now Admiral) A. H. Markham from his personal experiences on board the 'Arctic' whaler in 1873.[1] In addition to these there are many references to the subject in the journals of the voyages undertaken for Arctic discovery, and in the reports of the whalers themselves, many of whom are men of great intelligence.

It may be well first briefly to sketch in outline the course pursued by the whales in their annual migrations, leaving the details, more especially the autumn movements of the females and young whales, for fuller consideration later on. To the westward, the southern limit of the Right Whale's winter resort in the present day appears to be about the 57th or 58th parallel of north latitude off the Labrador coast. In April and May they are met with off the entrance to Hudson Strait and Resolution Island; the old males enter Davis Strait, and as the ice retreats make their appearance in the neighbourhood of Disco. Here they bear to the west, and crossing Baffin Bay join the female and immature whales which have arrived before them (coming north by a route through the heavier ice nearer the western shore), and wait the breaking up of the ice in Lancaster Sound, which generally takes place in July.[2] They then pass into the Sound, and disperse into Prince Regent's Inlet and other ramifications of the deep channels intersecting the Northern Archipelago, and spend the summer in these waters. When the ice begins to form in autumn, and it becomes necessary to beat a retreat, the whales commence their southward journey in a leisurely manner; and this also appears to be performed in two sections, the old male whales returning along the west shore of the bay and the females and young ones by a more circuitous route, which I shall endeavour to trace in due course. These routes I have laid down on the accompanying chart.

Dr Robert Brown is of opinion that the Right Whales which frequent Davis Strait in summer pass the winter and produce their young all along the broken water off the coast of the southern portion of that Strait, also in Hudson Strait and Labrador. The when and the where of the reproduction of this species is a very interesting question, and too large an one to enter upon here. It is certain,

[1] "A Whaling Cruise to Baffin Bay, &c., in 1873." London, 1874. The s.s. 'Arctic' in which Captain Markham sailed was lost in Davis Strait the next season, and her successor, a fine vessel of 522 tons, was so severely nipped in Fox Channel in 1887 as to render her abandonment in Cumberland Gulf necessary.

[2] These dates are only approximate; so much depends upon season, prevailing winds, and the varying condition of the ice.

however, whether or not this function is performed at that season, that the whales are found in the localities just indicated early in the year, and they have doubtless wintered there. Off Resolution Island the 'Arctic,' in which Captain Markham was a passenger, killed her first whale on the 23rd of May 1873; but, owing to the unsettled weather which usually prevails at this season, and to the dangerous nature of the ice, this, which is known as the 'South-west Fishing,' is not much frequented by the whalers. This is doubtless the starting-place of the most southerly contingent of the migrating army of whales in Davis Strait, and from this point the whalers, or such of them as have been to the south-west fishing, take their departure for the north at the end of May, and as a rule see no more of the whales till they reach the fishing-ground off Ponds Bay or Lancaster Sound. On their journey north the immature whales with the females, Captain D. Gray assures me, keep close along the west side of the straits, finding breathing-room in the cracks and lanes of water always found amongst the ice, and arrive at or near Eclipse Sound about the 15th of June.

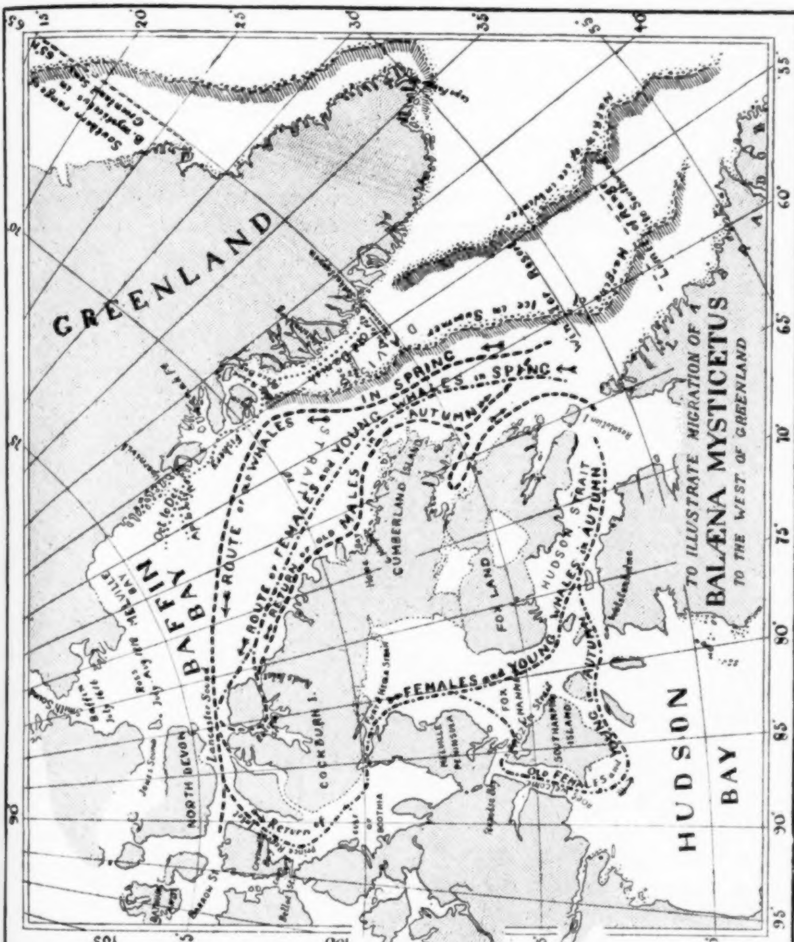
We will now proceed to the east side of Davis Strait, where a totally different disposition of the ice, and consequent distribution of the whales will be found. Fortunately, there exists a very remarkable set of records in connection with a whale fishery established here by the Danish Government, and these have been analysed by Messrs Eschricht and Reinhardt (*op. cit.*). These Stations or 'Factories' extend along the shore of West Greenland for a distance of 200 Danish miles, from the 60th to the 73rd degree of north latitude, in a direction almost due north, but only part of this extent of coast is, or was, visited by the Right Whale, the most southerly station being Sukkertoppen, in latitude 65° 25′ N., and the most northerly, Upernavik, in 72° 48′ N. At these factories the fishery was prosecuted from the shore by means of boats, a look-out being kept. When a whale was discovered, weather and ice permitting, the boats put off, and, if successful, towed the dead whale ashore, where it was flensed. Accounts were kept and returns made to the Colonial authorities at Copenhagen, not only of every whale killed but also of those seen from the look-outs. These records extend from 1780 to about 1839, and from them it appears that the whales were seen at Sukkertoppen in the months of December, January, and February, when they entered the larger sounds and fjords in very unequal numbers, in greater numbers the more severe the winter and the more the sea was filled with floating ice. Bearing in mind that the winter condition of the ice in the parallel of 65° on the east side of the Strait would about correspond with that on the Labrador coast five degrees farther south at the same time, and the fact of the whales appearing in greater and less numbers in accordance with the

severity of the weather, this more northerly wintering station is quite in conformity with the habit of these creatures of at all times frequenting the loose ice on the margin of the pack. At Holsteinborg (66° 56′ N.) the whales, as recorded in the journals, made their appearance generally in the first half of December, and remained along the coasts or in the fjords till March. Further north, in Disco Bay (about 69° N.) they appear about the same time as at Holsteinborg, but stay longer, generally having departed by the middle of June;[1] whilst in Omenak Sound (71° N.) "they are found not only through the whole month of June," but even as late as the beginning of July. Finally, between Proven and Upernavik, situated between 72° and 73° N, "the whales make their appearance considerably earlier than at the more southern parts of the coast. They have been regularly observed there by the month of October, and in some instances even at the end of September. They are then seen through November and some part of December, and again towards spring from April to July," evidently indicating a double migration. These writers further observe that, so far as can be ascertained by records dating back to 1721, although the numbers are vastly reduced, there has been absolutely no change in the time or route of the migrating whales. It must be understood that these observations all refer to the east side of the Strait, where the extent and condition of the ice differ entirely from those prevailing in the same latitudes on the west side.

Before following the whales to the westward, it will be well to ascertain, if possible, how far their range extends in the direction of Smith Sound. Baffin, who was the first to penetrate to this northern latitude, in the year 1616, saw many whales in Wolstenholme Sound, also in 78° N., at the entrance of Smith Sound; Ross, too, in the year 1818 met with whales between 75° and 76° N. in July and August, during which months, it will be remembered, they are absent from the coast along which the Danish Factories are situated; but I am inclined to think these instances are quite exceptional and that the Right Whales seldom penetrate farther north than latitude 75° or perhaps occasionally to the entrance of Jones Sound. That they are to be looked for with success in the extreme north appears very improbable, and on this point Captain (now Colonel) Feilden, the naturalist to the voyage of discovery under Sir G. S. Nares in 1878, speaks very decidedly; he says[2] "I am, however, quite satisfied on one point, and that is, no whale could inhabit at the present day the frozen sea to the north of Robinson Channel. To penetrate thither from the north-water of Baffin's Bay would be a too hazardous

[1] Here whales are sometimes taken by the whalers on their way north in the month of May.

[2] "Narrative of a voyage to the Polar Seas during 1875-6, with Natural History Notes," by H. W. Feilden. 2 vols. London, 1878. Vol. ii., p. 197.


GREENLAND
BAFFIN BAY
HUDSON BAY
HUDSON STRAIT
CUMBERLAND ISLAND
COCKBURN I.
NORTH DEVON
FOX LAND
SOUTHAMPTON ISLAND
ROUTE of FEMALES and YOUNG
FEMALES and YOUNG
OLD MALES
IN SPRING
AUTUMN
TO ILLUSTRATE MIGRATION OF A
BALÆNA MYSTICETUS
TO THE WEST OF GREENLAND

task for this great animal, and in this opinion the experienced whaling quartermaster who accompanied the expedition coincided. We may dismiss from our minds the idea or hope that nearer the pole, and beyond the limits of present discovery, there may be haunts in the Polar Sea suitable for the Greenland whale; . . . and I see no hope of Arctic discovery increasing our knowledge of the range of this animal." That it is impossible for the whales to pass more than a very limited period in ice of too close a texture is certain, as it would not only impede their breathing but also prevent their feeding, for both of which purposes open spaces are necessary. That whales are subject to the risk of suffocation is beyond doubt, and Eschricht and Reinhardt (*l.c.*, p. 12) quote an instance of its actual occurrence from an old MS. account by a Mr Geelmuyden, who states that in the year 1750 "the masses of ice in Disco Bay were uncommonly large, staying there until the year was far advanced; that the fishing therefore, generally speaking, had been very bad, but that the Greenlanders had been fortunate enough near the Dog's and Whale's Islands, at the outlet of Disco Bay, to find no less than fourteen whales, 'which had perished by themselves beneath the ice,'" evidently suffocated for want of breathing spaces.

It was not until the year 1817 that the whalers ventured to enter the pack in Melville Bay, and until the introduction of steam the passage through this dreaded obstruction was by no means certain. Now, however, having reached the 'north-water' of Baffin Bay some time in June, they are accustomed to find the whales waiting the disruption of the ice at the entrance of Lancaster Sound.[1] As soon as that takes place all the whales pass up the Sound, and entering Prince Regent's Inlet, or it may be some of them continuing into Barrow Strait, remain until the autumn ice compels them to return southward. How far west the whales extend their wanderings in this plexus of Straits and Sounds it is difficult to say, but it seems probable that they do not pass in that direction much beyond Prince Regent's Inlet or a short distance into Barrow Strait, seldom so far as to meet the whales from the Pacific side, which probably also do not penetrate far into the narrow ice-bound channels between the islands of the Northern Archipelago. The only Cetaceans which I have found mention of in Jones Sound are White Whales, and these appear to be very numerous in that locality.

It has been observed that in the return or southward migration along the west side of Davis Strait in autumn, there is an absence of female and immature whales, and the question arises, by what route do they return? This I will now endeavour to trace. Sir John Ross, on the 15th of August 1829, when off Bellot's Strait, said "many whales of a light colour [a sign of immaturity] came close to

[1] The 'Arctic' took four small whales here on 15th of June 1873.

us, appearing to be quite indifferent to the presence of the ship"; also on the 20th "many whales," and on the 21st two "large whales," and finally in 70° 54′ N. on the 22nd a "large whale," after which I do not find mention of any others being seen. Markham, whose journey extended to Cape Garry,[1] says the whales were all heading along the Inlet to the Gulf of Boothia, where Captain Adams had at one time thought of following them through Fury-and-Hecla Strait and Fox Channel, or through Frozen Strait into Hudson Strait, an intention he unfortunately abandoned; but he evidently had a shrewd idea that such was the course taken by the whales. Ross, in the appendix to his second voyage, mentions that the natives of Boothia told him the Right Whale "is rarely seen either on the east or west side of the Isthmus . . . only two were seen by us during the three years we were frozen up in that neighbourhood." This seems to indicate that they cross the head of the Gulf to the unexplored coast of Cockburn Island and pass through Fury-and-Hecla Strait, for Dr Richardson tells us, in the appendix to Parry's Second Voyage (p. 336), that they are frequently seen near the shores of Melville Peninsula, in Frozen Strait, and in Hudson Strait; whilst at p. 510 of the narrative of the same voyage, it is stated that the natives meet with most whales on the coast of Eiwillick, where the Hudson Bay Company once carried on a whale-fishery, but had then (1825) abandoned it for some years. It is worthy of note, as indicating the direction in which the whales were travelling, that during Parry's stay off the coast of Melville Peninsula the only month in which he saw these animals was August, and the earliest dates are in localities farthest north; thus, about the 5th of August (1822) they saw Black Whales off the east entrance to Fury-and-Hecla Strait; on the 17th of August (1821) a "great number" of Black Whales were seen playing about the beach off Frozen Strait; on the 22nd more were seen in Repulse Bay; and on the 28th of August three Black Whales were seen off Rouse Island in Hurd Channel; these latter were probably on passage to Rowe's Welcome. No whales were seen going north in the earlier part of the year, and indeed the late date at which the ice breaks up in these narrow straits would render it quite impossible for them to be used by the whales on their spring passage north, and it is not unlikely that this is one of the reasons for their going north by Davis Strait.

We have thus traced the whales through Lancaster Sound into Prince Regent's Inlet, have found them abundant in the neighbourhood of Cresswell Bay and Bellot Strait, rare on the east coast of Boothia, owing, it is suggested, to their crossing the Gulf at this point

[1] It is worthy of mention that the 'Arctic' killed an old female and a small male whale at this spot on August 9th and 11th respectively, during which month they are not often met with in Lancaster Sound.

to pass through Fury-and-Hecla Strait, at the east entrance of which we again find them abundant, as also all along the shore of Melville Peninsula into Hudson Strait. A detachment goes west through Frozen Strait into Repulse Bay and Rowe's Welcome (where the 'Perseverance' has wintered for the three past seasons, securing six whales), and finally, either winters in that locality or passes round by Southampton Island, and rejoins the main body to winter in Hudson Strait or thereabout. The route will be found marked on the accompanying chart (Pl. xii.), for which I am mainly indebted to Captain David Gray, and however unlikely it might seem for the whales in any number to pass through so narrow a passage as Fury-and-Hecla Strait, there appears every reason to believe that this is really the route chosen by a definite section.

It is a much more simple matter to follow the old whales on their return journey along the west side of Baffin Bay and Davis Strait. At the approach of winter, when the young ice begins to cover the bays, the old whales turn southward, many of them passing through Eclipse Sound and Pond's Inlet. They travel along the west side of the strait, being due at Home Bay and Cape Hooper about the 15th of September. From their habit of hugging the shore (a habit which it will be remembered they share with the whales found under similar circumstances on the east coast of Greenland), these whales are known as 'rock-nosers.' They continue working south till they reach Cumberland Gulf, which is their last resting-place before the accumulated ice drives them into the more open water farther south. There they remain until the returning spring enables them once more to commence their northward migration along the broken margin of the ice trending towards the east side of the strait. So well are these different lines of migration recognised by the whalers, and so constant are the characters of the individuals using them, that, as in the Greenland seas, they are by some regarded as different 'races,' and called after the localities in which they are found, as 'middle-icers,' 'rock-nosers,' and 'Pond's Bay fish,' but, as Dr Brown remarks, these distinctions do not designate separate "species, or even varieties, but express a geographical fact and a zoological habit" (*l.c.*, p. 80).

As mentioned when speaking of the whales inhabiting the seas to the east of Greenland, there is also abundant evidence of the Davis Strait whales likewise frequenting the same locality year after year; perhaps the most recent instance of this is the most remarkable. In September 1894 Captain M'Kay of the 'Terra Nova' killed in Davis Strait an unusually large whale, in the blubber of which he found a harpoon, the steel of which was quite bright, bearing the name of the 'Jean' of Bo'ness, dated "forty years back." The 'Jean'

of Bo'ness was lost in Davis Strait "thirty-seven years ago"; the whale must therefore have frequented Davis Strait for at least thirty-seven years.

It is an open question whether an interchange of inhabitants ever takes place between the regions lying to the east and west of Greenland, and, if so, by what route it is effected. Dr Brown is strongly of opinion that the whales of Spitzbergen never as a body visit Davis Strait. Sir William Flower, in a lecture delivered at the Royal Colonial Institute,[1] says that "though found on both sides of Greenland, and passing freely from one side to the other, it is never found so far south as Cape Farewell." Whilst quite agreeing with the latter part of Sir William Flower's statement, such being admittedly the case, the southward passage not being available for them, I could wish that this eminent authority had indicated by what other means the interchange might take place. Supposing the whales to pass round the north of Greenland,[2] the heavy ice in the upper reaches of Kennedy and Robinson Channels would be fatal to their reaching the west coast, and Cape Farewell for many reasons is out of the question. When it was believed that a passage existed through Mid-Greenland from sea to sea, no insuperable barrier to such an interchange appeared to present itself, but it seems impossible that it should be accomplished by means of any passage known to us in the present day. Let us look at the evidence. The only instance of the supposed passage from Davis Strait to Greenland seas with which I am acquainted, is on the authority of Captain D. Gray, who admits that he has found little evidence of such an interchange. He says, however, that the 'Kate' of Peterhead, in 1866, in 80° N., killed a small whale in which was found an Esquimaux harpoon; this he considers conclusive proof of its Straits origin, "there being no natives on the east coast of Greenland;" as, however, he is wrong in this supposition, the occurrence is of no value. Some of the stories of such visits of Greenland whales to Davis Strait are very circumstantial; I will only give two which appear to be the best substantiated. The first is from Eschricht and Reinhardt (*l.c.*, p. 24), and they rightly remark that "if it can be completely depended upon, it is deserving of peculiar mention." It is derived from an account given by Paul Egede, to the effect that the commander of a whaling expedition (in 1787) in Davis Strait found a whale drifting with a harpoon sticking in it, which he recognised as that of his brother, and which, on his return, he learned had been put into the whale near Spitzbergen only two days before he found the animal dead in Davis Strait. The second instance I give from

[1] *Journ. Roy. Col. Inst.*, February 1895, p. 163.

[2] The most northerly known point of North Greenland extends to 83° 24′ N., and Peary thinks it likely it reaches even to 85° N.

Dr Brown's "Notes on the Cetacea of Greenland," as reprinted in the "Arctic Manual" (p. 76). "I was told," says Dr Brown, "by the late Captain Graville of the s.s. 'Diana,' a proverbially experienced and truthful man, that a whale was struck near the entrance of Scoresby's Sound, on the east coast of Greenland, by the father of the late Dr Scoresby (with whom Mr Graville was a fellow-apprentice); but, being lost, it was killed next day near the entrance of Omenak Fjord, on the east coast, with the harpoons freshly imbedded in its body. This was adduced in proof of the existence of an inlet in former times (as, indeed, represented on old maps) across Greenland between these two points. Unless the whole story was founded on a misconception (an event even less likely from the searching investigation which took place at the time), we can scarcely believe that the whale could have reached the west coast by any other means; for, even allowing the greatest credible speed, it comes scarcely within the limits of possibility that it could have doubled Cape Farewell and reached 70° N. latitude within the interval mentioned." Here I must leave these wonderful but apparently well-accredited stories, simply remarking that with our increased knowledge of the geography of Greenland, and of the habits of the Right Whale, they seem even more wonderful than ever.

When considering the migration of the Right Whale in the Greenland Seas, I briefly stated the difficulties, if not the impossibility, of their passing from the Pacific to the Atlantic, or the reverse, along the northern shores of Europe and Asia. It may be well to say a word in passing with regard to the probability of such an interchange along the coast of North America. The 'Bowheads' (by which name the Northern Right Whale is known to the Americans) wintering in the North Pacific are seen by the natives of Alaska, as stated by Captain Macguire, of H.M.S. 'Plover,' to make their appearance off Cape Hope in April and May, when the ice breaks up into fields, and most of them have disappeared before the ships are able to follow them. They then pass through Bering Strait, a portion going westward, but to no great distance (see *ante* pp. 404-5); but the bulk bears to the east, where they are pursued by the natives of Alaska, and followed, as soon as the ice permits, by the American whalers, who, since the year 1848, when they first passed the Strait, have established a lucrative fishery in the neighbourhood of Point Barrow. Probably, owing to the difficulty of passing this icy promontory, they do not follow the whales much further east, but the Esquimaux pursue them as far as Cape Bathurst, their season commencing on the 7th of May, and continuing till the month of June, at which time the whales disappear, to return on their way to their winter quarters in August and September; in July and early August they are seldom seen. On the 19th of Sep-

tember the 'Investigator,' whilst struggling in the ice in Banks Strait, between the north of Banks Land and Melville Island, saw two Right Whales going to the westward, apparently on their return journey to Bering Sea. Thus there seems every probability that the Pacific whales do visit the Polar Archipelago and return to their native seas; but they reach this, the limit of their journey in an easterly direction, so late in the season that it seems unlikely they should mingle with, or, perhaps, even more than occasionally meet with, the contingent from Baffin Bay.

There are several apparently well-authenticated instances on record of harpoons having been found in whales killed on the Pacific side of the globe, which were identified as having belonged to the Greenland (West Greenland?) whalers.[1] G. Brown Goode, in the volume of the Census Report of the U. S. Commission of Fisheries for 1887 (p. 97), says that whales have been taken in the neighbourhood of Point Barrow with harpoons in them bearing the marks of vessels that had been pursuing the fishery in the vicinity of Davis Strait, and gives the details of such an occurrence. Scoresby also mentions some instances of supposed Pacific whales having been killed in Greenland; but I do not attach much importance to them, since the stone lances and bone harpoons on which he relies, and which are attributed by him to the Esquimaux of the Pacific coast, might almost as well have had their origin, perhaps many years previously, seeing how long lived these cetaceans are, on the shores of Baffin Bay. Admitting the instances quoted to be genuine, they merely go to prove that should an interchange of Atlantic and Pacific whales take place it is much more likely to be by way of the 'North-west Passage' than along the shores of Asia and Europe. That the Right Whales inhabiting the two seas are specifically distinct there is no reason to suppose; some racial difference there may be, but even this has never been clearly defined.

T. SOUTHWELL.

10 THE CRESCENT, NORWICH.

[1] See Eschricht and Reinhardt, p. 46.

SOME NEW BOOKS

The Teaching of Botany: a Contrast

Elementary Botany. By Percy Groom, M.A. 8vo, pp. x+252. With 275 figures. London: Bell & Sons, 1898. Price, 3s. 6d.

Lessons with Plants. Suggestions for seeing and interpreting some of the common forms of vegetation. By L. H. Bailey. With delineations from nature by W. S. Holdsworth. 8vo, pp. xxxi+492. New York: The Macmillan Co., 1898. Price, 7s. 6d.

Mr Groom has produced a very serviceable little text-book for beginners in botany. It is an ominous sign that a man trained at Cambridge and writing from the Oxford botanical school should be the author of a botanical book for the proper understanding of which the use of a compound microscope is quite unnecessary. Such, however, is the case, and though, in our opinion, no aid to the imparting of knowledge should be despised, we welcome a recognition of the fact that a very great deal may be learned about plants with the help of a sharp penknife and a pocket-lens. The microscope is fascinating, but the beginner is apt to be bewildered by overmuch detail, and lose sight of the broad principles of general form and function. In recommending this book to teachers of elementary classes, we suggest that an occasional and discreet use of the microscope will be a gain.

The work, which deals only with seed-plants, falls into the usual three parts—general morphology, classification, and physiology. It is extremely difficult to clothe the bare facts of morphology so as to make them interesting, and Mr Groom fares neither better nor worse than many other authors; one chapter of the thirteen devoted to this section, that, namely, on pollination, may perhaps be read. For the rest, Part I. excellently fulfils its function as a text-book, that is a complement to the lesson and practical class. Similarly, Part II. is an excellent guide to the study of about thirty of the more important natural orders; but it is a pity to repeat in an elementary book the fable of the 'distinct disc' in Geraniaceae; it is as distinct as the perigyny in British Leguminosae. *A propos*, also, of the general table of classification, we notice that the ovary of Liliaceae is said to be inferior—an obvious slip. The same, however, cannot be said of the inclusion of Iridaceae under the head 'flowers actinomorphic'; the zygomorphic *Gladiolus* is so well-known a flower and the second largest genus in the order, that some qualification of the clavis character is advisable. Part III. (Physiology) is somewhat brief, but up-to-date and accurate. Finally, a word of praise is due to the profusion of illustrations, which are clear and helpful without being in the least elaborate.

Perhaps it is hardly fair to compare the second book before us with the one just noticed. Mr Groom's is an elementary text-book, good, but without pretensions to literary excellence or striking originality. Prof. Bailey's is a series of lessons learnt from the plants, but learnt as a child learns, gradually and by intimate association with the objects themselves. And it is also a book to read, for Prof. Bailey

has a style of his own, bright, easy, and readable; we almost forgive him his unfamiliar spelling. It would be an interesting experiment to compare the results of teaching on the plan of these two books respectively. The text-book might perhaps score most in examinations with a restricted syllabus, though we are not certain even of this, but for mental development and the fostering of a love for plant-knowledge Prof. Bailey's 'Lessons' would be *facile princeps*. The best description of the book is its title. Its use to the teacher is to suggest what material to put before his students, and what lesson to let them imbibe from it; only, as the author insists, one lesson at a time. If the teacher is worth his name, he will find no difficulty in extending the scope of the book on the same lines, and he will also find that he is learning as much as his pupils. When the student has not the advantage of a teacher, Prof. Bailey puts him well in the way of helping himself. But neither teacher nor student must rest satisfied with the pictures with which the book is so lavishly supplied. They will help wonderfully to elucidate the living specimens; but if they are used instead, the object of the book will be frustrated. It is worth the price of the volume to get almost for every page a new illustration. Dear old Sachs & Co. were very useful, but the blocks have got much worn of late. But it is impossible to review this book. One keeps looking at the pictures and reading bits, and the editor wants copy to-morrow. Suffice it to say that it is divided into seven parts: studies of twigs and buds; of leaves and foliage; of flowers; of the fructification; of the propagation of plants; of the behaviors (*sic*) and habits of plants; and of the kinds of plants; with an appendix containing many useful suggestions on the collecting and preserving of plants, on books, on how to build a school-house and lay out the garden, and a glossary. Long live Professor Bailey!

The American Bureau of Ethnology

Four volumes of the "Annual Reports of the Bureau of Ethnology" are to hand, being the fourteenth (two volumes), fifteenth, and sixteenth Reports, 1892 to 1895. The usual high standard of this important ethnological publication has been amply maintained, both in the subject material and in the style of production. As hitherto, the illustrations are very numerous and excellent.

The fourteenth Report (1892-3), Part I., forms a bulky volume containing two important and lengthy papers. The first is a "Monograph on the Menomini Indians," by W. J. Hoffman, M.D., a detailed descriptive account of a tribe of Indians of Algonquian stock, nearly related to the Ojibwa, and located on a reservation in the N.E. part of Wisconsin. This tribe has been referred to in print under upwards of eighty synonyms, which are quoted in a list. The paper deals in detail with the form of government, the various societies associated with special cults, mythology and folk-lore, everyday life and manufactures, describing the various appliances used in the various occupations. There is no lack of illustrations, and a vocabulary is appended. The arrangement of the paper is systematic, and is thus well suited to quick reference, the list of contents and headings to sections rendering easy the search for special points. These mono-

graphs upon special tribes are of great value to the ethnographer, and it is much to be desired that their general plan of arrangement should be as uniform as possible.

The second half of this volume is devoted to an elaborate historico-ethnological paper by G. P. Winship on "The Coronado Expedition of 1540-42." The narrative of this, together with the earlier expeditions of Francisco Vasquez Coronado, forms a chapter in the history of the Spanish conquest of America. The Spanish text of Castañeda's narrative is given in full with a translation, and translations of several other accounts, communicated by other writers in the form of letters to various people, are also given. The reproductions of a number of important sixteenth century maps add much interest to the historical information conveyed in these narratives, while the excellent photographs of the modern Pueblo Indians, their dwellings and occupations, serve admirably to illustrate the incidental passages which have reference to the manners and customs of the native inhabitants of New Mexico in the sixteenth century. The early ethnographic observations are of value as giving an indication of the amount of change which the native culture has undergone since the Spanish invasion of the country.

Part II. of the same report is a volume devoted to a very exhaustive paper upon the "Ghost-Dance Religion and the Sioux Outbreak of 1890," by James Mooney, a writer eminently qualified, by his long personal acquaintance with the customs and ritual of the Indian tribes, to act as chronicler of the curious circumstances which for a while created so much stir and trouble but a few years back. Mr Mooney has mapped out the area of the ghost-dance, showing a wide distribution in the Central and Western States of North America. He treats his subject historically, dealing with the relations between the Indians and the Whites, and the causes of the various outbreaks of the former in their endeavour to throw off the yoke of the latter. Most, if not all, of the Indian tribes have held belief in the coming of a Messiah or Deliverer who will restore them to their original happy state, and numerous prophets have arisen who have taught the religious dances, which may collectively be classed under the term Ghost-Dance, and which are elaborately symbolic, relating to the doctrine of the future blissful state. The history and acts of the celebrated 'Messiah' Vovoka are gone into in detail, together with the causes of the recent Sioux outbreak. A mass of material of both historical and ethnological interest is brought together in the paper. The individual campaigns are described and illustrated by maps. Of special interest to ethnographers is the minute description of the ceremonials of the ghost-dance, and the extensive collection of myth-songs recorded.

The Fifteenth Report (1893-4) contains a paper by W. H. Holmes on "Stone Implements of the Potomac-Chesapeake Tidewater Province," in which the author makes a detailed and plain statement of his views as to the nature of the 'quarry-workshops' and their products, reasserting his belief in the necessity of attributing them to the agency of the historic Algonquian Indian instead of referring them to a remote period and a different culture. Much, of course, is repeated from his former papers on the subject, but so plain and straightforward a statement of his views, which are very convincing, must

facilitate discussion and tend to focus it. His description of the steatite working is of much interest.

This is followed by a general paper on the "Sioux Indians" by W. J. M'Gee, describing briefly their general culture and beliefs, and serving as introduction to a posthumous paper on "Siouan Sociology" by J. O. Dorsey, dealing with the tribal divisions of the Dakota.

J. W. Fewkes furnishes a paper upon "The group of Tusayan Ceremonials called Katcinas." The complex symbolic performances, in which masked figures impersonating mythological beings play a large part, are treated very fully, and illustrations of the performances and appliances embellish the paper, which is not the least important of the published results of the Hemenway expedition.

A paper describing the work upon the "Repair of the Casa Grande Ruin" by Cosmos Mindeleff terminates this volume.

The Sixteenth Report (1894-5) commences with an elaborate memoir on "Prehistoric Trephining in Peru," by M. A. Muniz and W. J. M'Gee. The subject of trephining as exhibited by primitive peoples has been kept very much alive of late years, and this finely-produced and well-illustrated paper is a welcome addition to the literature. It refers to the practice in Peru in pre-Columbian times, and evidences several methods by which trepanation was effected, chiefly or wholly produced by operation with stone implements. Post-mortem trephining and 'cranial amulets,' as described by Broca, are not evidenced in the Peruvian collection. The number of trephined skulls averages 2 per cent. in a collection of one thousand brought together by Dr Muniz; one example exhibits triple trephining.

The next paper, by Mr Cosmos Mindeleff, deals with "The Cliff Ruins of Canyon de Chelly, Arizona." The extraordinary cliff dwellings and villages, in which the caves and rock shelters of the canyon have been supplemented with masonry to a greater or less extent, are very fully described, and, although seemingly belonging to a specialised condition of culture, they are none the less, in the writer's opinion, to be regarded as, for the most part, "subordinate structures, connected with and inhabited at the same time as a number of larger home villages located on the canyon bottom." He urges that they served not so much for purposes of defence as for outlooks, whence the adjacent cultivable areas could be viewed. They present advanced methods of construction, and cannot therefore be regarded as primitive, and in many cases must be referred to comparatively recent times, within the historic period. First-rate reproductions of photographs and plans illustrate the paper.

The "Day Symbols of the Maya Year" by Cyrus Thomas follows, and the volume ends with a description by Dr Fewkes of the "Tusayan Snake Ceremonies." Since the publication of Captain J. G. Bourke's well-known book on the snake dances in 1884, many fresh localities, where these ceremonies obtain, have been discovered. The rituals throughout are closely related, but local divergences are observable, and a careful comparison of these will tend to throw light upon the origin of the ceremonial. The details of the Tusayan dances are very interesting, and the comparative method of treatment of the subject is very instructive, though the elucidation of the true significance and symbolism of the cult is one presenting great difficulties. H. B.

Serials

The March number of the *American Naturalist* is almost entirely devoted to an account of Louis Agassiz, who, in March 1848, began his course of zoological instruction at Harvard University. Articles are contributed on various aspects of the work of the great naturalist, as follows:—"The Philosophical Views of Agassiz," by A. S. Packard; "Agassiz and the Ice Age," by G. F. Wright; "Agassiz on Recent Fishes," by David Starr Jordan; "Agassiz's Work on Fossil Fishes," by C. R. Eastman; "Agassiz's Work on the Embryology of the Turtle," by Gertrude C. Davenport; "Agassiz at Penikese," by Burt G. Wilder. The *American Naturalist* was started by pupils of Louis Agassiz, and indeed most of the eminent zoologists of the United States were his pupils, so that it is only fitting that it should commemorate in this manner so important a jubilee. An excellent photograph of Louis Agassiz is reproduced as the frontispiece.

Nature for May 5 contains, as the thirty-first instalment of its well-known series, "Scientific Worthies," an account of Prof. Albert von Kölliker, by Mr W. F. R. Weldon, illustrated by an admirable portrait.

Further Literature Received

Students' Text-book of Zoology, Sedgwick: Sonnenschein. History of Fowling, Macpherson: Douglas, Edinburgh. Flora of Perthshire, White: Blackwood, Edinburgh. Garden-Making, Bailey: Macmillan, New York. De Danske Barkbiller, Lövendal: Schuboth, Copenhagen.

Contents-Subject Index, 7, 8, 9, 10, Cotgreave. Problems of Plant-Physiology, MacDougal: *Science*. Summer School of Biology on Illinois River, Forbes. Bulletin U.S. Dept. Agriculture, Entomology, N.S., Nos. 10, 12, and 13. Report Museums Assoc., 1897. Contribution to Theory of Warning Colours, Nos. 3 and 4, Finn: *Journ. Asiat. Soc. Bengal*. Notes on Introduction of Brown Hare into Ireland, Barrett Hamilton: *Irish Nat.* Ninth Ann. Rep. Missouri Botanic Garden. Catalogue of Land-Shells of America, N. of Mexico, Pilsbry & Johnson: *Nautilus*. Wing and Larval Characters of Emperor Moths, A. R. Grote: *Proc. S. London Entom. Soc.* Maryland Geol. Survey, vol. i. Second Ann. Rep. New York Zool. Soc. Reports on Water-Supply of Goldfields in Western Australia, Govt. Geologist. Trans. Oxford Univ. Jun. Sci. Club, N.S., Nos. 3 and 4. Report Rugby School Nat. Hist. Soc., 1897. Rep. Cheltenham Coll. Nat. Hist. Soc., 1897. Case of Protective Coloration in House Mouse, Jameson: *Linn. Soc. Journ. Zool.* Proc. Biol. Soc. Washington, vol. xii., pp. 85-129. Metric Equivalents of Imperial Weights and Measures: *Pharmaceut. Journ.* Mem. Soc. Cient. Antonio Alzate, vol. xi., Nos. 1-4. Habits and Economy of Birds, Finn; *Proc. Asiat. Soc. Bengal*.

Amer. Monthly Micr. Journ., April; Scot. Geogr. Mag., May; Scot. Med. and Surg. Journ., May; Amer. Journ. Sci., May; Amer. Nat., Mar.; Victorian Nat., Mar.; Annot. Zool. Japan, vol. ii., pt. i.; Botan. Gazette, April; Irish Nat., May; Westminster Rev., May; Journ. Essex Tech. Lab., vol. iii., Aug.-Dec., 1897; Journ. Marine Biol. Assoc., V., No. 2; Journ. School Geogr., April, May; Knowledge, May; Literary Digest, April 9, 16, 23, 30, May 7; Naturae Novit., Mar., Nos. 5, 6, April, No. 7; Naturalist, May; Nature, April 14, 21, 28, May 5, 12; Nature Notes, May; Naturen, Mar., April; New Age, Feb.; Plant World, Mar., April; Psychol. Rev., May; Review of Reviews, April; Rivista Quindicinale di Psichologia, April 1, 15, May 1; Revue Scient., April 16, 23, 30, May 7, 14; Science, April 8, 15, 22, 29, May 6; Scientific Amer., April 9, 16, 23, 30, May 7.

OBITUARIES

HENRY LEWIS

BORN AT WALWORTH, 1834. DIED AT WANDSWORTH, 10TH APRIL 1898.

ON Easter Day there died one whose name is perhaps but little familiar to our readers. Henry Lewis was what would be called an uneducated man, in a small way of business as a bootmaker. But with him business was subordinate to the pursuit of knowledge, his special delight being the collection of facts concerning pre-historic man. We are indebted to Mr W. J. Lewis Abbott, himself a well-known worker in the same field, for an enthusiastic appreciation of Lewis' work. Space forces us to be content with a few extracts.

"For several decades he has been tramping the country from Suffolk to Barton, obtaining thousands of interesting specimens, which throw a flood of light upon Bronze, Neolithic, Palaeolithic, and Plateau man, neglecting the more lucrative following of his trade, and denying himself almost the necessities of life. Without a word of help or encouragement he was content to plod along, working at every pit or opening likely to yield the objects of his quest For many years he was one of the best known collectors in any pit in the Thames Valley, and men got to like him so thoroughly for his straightforward earnestness, and his willingness to impart his little knowledge, that they would let him have implements on credit; and although months elapsed before they were paid for, notwithstanding his weekly visits, we have heard rough-handed, square-hearted labourers remark, 'Oh, he's all right, he'll pay when he gets some money.' Perhaps no man set more labourers to work to find implements than Lewis, and thus it is impossible to calculate the effect of his life-work. Upon hearing of Skertchley's finds at Botany Bay, and the discredit with which they were unjustifiably received, he set off to the scene of dispute, and there secured not only far better implements than Skertchley had found, but bulbed and worked flakes also. For some years we have directed him to numerous so-called preglacial gravels to hunt for striated bulbed flakes or implements, and the number of these he obtained will surprise most people when an account of them is published. Although he never wrote very much, his labours have been made known by Mr Arthur Evans in connection with the interesting bronze finds at Aylesford. We have seen him taking bands of working men round the British Museum galleries. Bloomsbury knew him well, but Sir Augustus Franks, despite his unparalleled generosity and deep learning, cannot be said to have been unduly prejudiced in favour of older pre-historic man. Twice during his struggles Lewis was visited by fire, which practically made a total wreck of him, and his implements had to be sacrificed to meet claims. From the effects of the last disaster he never recovered, and his business subsequently became of restricted dimensions.

"At last with the creeping on of old age and the effects of continued saturations and exposures, to which real field-workers are subject but from which arm-chair critics and moneyed collectors fortunately escape, his throat and chest grew gradually worse. His last effort was to try and write to Mr Benjamin Harrison, giving a new argument in favour of Plateau Man."

KARL LUDWIG FRIDOLIN VON SANDBERGER

BORN 22ND NOV. 1826 AT DILLENBURG, NASSAU. DIED AT WÜRZBURG, APRIL 11TH, 1898.

IT is over half a century since this veteran geologist commenced author. He is perhaps best known for the work written in collaboration with his brother Guido, "Die Versteinerungen des rheinischen Schichten-systems in Nassau," which was published during the years 1850-56, and has ever remained the classical account of the geology and palaeontology of that region. In consideration of this work the authors received the Wollaston Fund from the Geological Society of London in 1855. The next important work on which Dr Sandberger engaged was an account of the shells of the Tertiary Basin of Mayence (1863). The studies made in connection with this gave rise to a general account of fossil land and fresh-water shells, which was issued in two volumes, 1870-75. Dr Sandberger studied many other fossil Mollusca, as well as the structure of the Brachiopoda. In later years, however, he turned his attention chiefly to mineralogy, and in 1882-85 published his "Researches on Mineral Veins." He also made many contributions to the study of the microscopic structure of eruptive rocks. In 1849 Fridolin Sandberger was made curator of the Natural History Museum of Nassau, and in 1854 went to the Karlsruhe Polytechnic as Professor of Mineralogy and Geology. Here he stayed till 1863, when he was called to Würzburg to fill the chair of Mineralogy, to which Geology was then added for the first time. This post, which carried with it the direction of the Mineralogisches Institut, he held till a short time before his death. The Geological Society of London elected him a foreign member in 1875, and in the following year he received the Cothenius gold medal from the Leopold-Caroline Academy.

JULES MARCOU

BORN AT SALINS, FRENCH JURA, 20TH APRIL 1824. DIED AT CAMBRIDGE, MASS., 17TH APRIL 1898.

WHAT interesting reminiscences Jules Marcou's would have been had he published them! A citizen of two hemispheres, writing with equal facility and spirit in French and English, the pupil of Thurmann, the friend of Agassiz, the explorer of the West, a historian of ancient maps and a maker of new ones, a lover of truth at all hazards, a hater of humbug, and a thorough-going fighter. Perhaps he has left a manuscript somewhere. At any rate, he did the next best thing in producing a life of Louis Agassiz, which both before and after publication stirred up a good deal of controversy. Above all things

Marcou was a geologist of the Jura, and an authority on the fossils found near his first home. In 1849 his "Recherches géologiques sur le Jura salinois" were published by the Geological Society of France, and in the same year he was appointed 'préparateur' in mineralogy at the Sorbonne, while in 1847 he was entrusted with the arrangement of the palaeontological collections in the Museum. In the following year he was enabled to go to North America as travelling geologist from the Paris Museum, and visited Agassiz, who had just begun his work at Boston. With him he went to the L. Superior region; after which he studied the geology of New Jersey, Pennsylvania, Virginia, and the Mammoth Cave. In June 1850 he returned to France, and prepared the first general geological map of the United States, published in 1853. In that year he went back to America, having been appointed geologist to the government expedition, which, under Lieut. A. Whipple, explored the 35th parallel from the Mississippi to the Pacific, for the purpose of a railroad. Thus he made the first discovery of Jurassic fossils in America. Illness forced him to return to Europe, and interfered with the preparation of his report. In 1855 he was appointed Professor of Geology at the Zurich Polytechnic, where he stayed till 1860, when he again returned to America and helped Agassiz in founding the Museum of Comparative Zoology. In 1862 was issued his geological map of the world, of which a new edition appeared in 1875.

To allude in detail to Marcou's numerous writings would be a lengthy task. It should not be forgotten that he proposed the name Dyas for the rocks usually called Permian, and, what is more, contributed to our knowledge of them in the Old and New Worlds. Among his controversial writings, one recalls his vigorous polemics on the Taconic and Jurassic rocks of N. America, and his attacks on the United States Geological Survey, which were not without effect. He always displayed deep interest in the history of the discovery of America, and had finished the manuscript of a fresh paper on the subject shortly before his death. In this work he was more than once assisted by his son, Mr John Belknap Marcou.

Among other losses to science we note the following:—On March 24, aged 64, ALFRED U. ALLEN of Bath, who was the secretary of the Postal Microscopical Society, and editor since 1882 of the *Journal of Microscopy and Natural Science*, the cessation of which we noticed a short time ago; Lieut. BRASSEUR, the Congo State traveller, in a fight with the Arabs on the banks of the Luapula; Dr MAX DAHMEN, the bacteriologist, at Crefeld; on April 12, aged 67, Prof. AIMÉ GIRARD of the Conservatoire des Arts et Métiers, Paris, and member of the section of Rural Economy of the Paris Academy of Sciences, a leading authority on vegetable fibres, wheat, sugars, and woods; Dr SAMUEL GORDON, president of the Royal Academy of Medicine in Ireland, and successor to the late Dr Haughton as president of the Royal Zoological Society, Dublin; on March 26, aged 26, BRADNEY B. GRIFFIN of Columbia University, author of papers on the fertilisation of the egg in *Thalassema*, the nemerteans of Puget Sound, and other subjects; at Elmina, West Africa, on April 19, aged 32, Dr JOHN SHEARSON HYLAND, F.G.S., for some time on the staff of the Geological Survey of Ireland as a petrologist, but latterly engaged in reporting on mineral resources in the United States and Africa; EDWARD KOKOSINSKI, the bacteriologist, at Lisle, on February 26th; Dr GIUSEPPE PALMA, assistant in Zoology at Naples University on January 18th; HERMANN PÜTZ, Honorary Professor of Veterinary Science at Halle on March 4th, aged 68.

NEWS

Mr Alexander Agassiz, Director of the Museum of Comparative Zoology, has been appointed Professor Emeritus of Harvard College by the President and Fellows in concurrence with the Board of Overseers.

Among other appointments we note: Dr Franz Steindachner to succeed Dr Franz v. Hauer as head of the Naturhistorische Hofmuseum in Vienna, himself being succeeded in the professorship of zoology by Friedrich Mor. Brauer; Dr Giovanni Battista Condorelli, as professor of natural history at the Gaeta Technical School; Dr Karl Chun of Breslau to succeed the late R. Leuckart, as professor of zoology at Leipzig; Dr Bela Haller, of Heidelberg, to be professor of zoology there; Pierre Fauvel of Caen, as professor of zoology at the Angers University; E. S. Goodrich to be Tomlinson-Aldrichian Demonstrator of Anatomy at Oxford University; Dr Alessandro Coggi of Bologne, as professor of zoology, anatomy, and physiology at the Perugia University; Harold Heath of Pennsylvania University, to be assistant professor of zoology; Dr Karl Hischeler, assistant in the Zoological Laboratory of Zürich, to be privat-docent; Dr Henry T. Fernald, to be economic zoologist of the State of Pennsylvania; Dr G. J. Born of Breslau, to be full professor of anatomy in that university; Dr A. L. Bolk, to be professor of anatomy at Amsterdam University; Mr W. J. Gies, as instructor in physiology at Yule; and Messrs A. H. Redland and H. E. M'Dermott, as assistants in the same office there; Dr Glaister, to be professor of forensic medicine in Glasgow University, in succession to Dr P. A. Simpson; Dr W. J. Simpson, late Health Officer of Calcutta, to be professor of hygiene in King's College, London.

Dr Otto Warburg, to be titular professor of botany at Berlin University; Dr E. Zacharias, to be director of the Botanical Garden at Hamburg; Alfred J. M'Clatchie, of the Throop Polytechnic Institute, Pasadena, Cal., to be professor of agriculture and horticulture in the University of Arizona at Phœnix; Prof. F. W. Card, of Nebraska University, to be professor of agriculture in Rhode Island University; Cornelius L. Shear, to be assistant agrostologist in the U. S. Department of Agriculture; Dr Jenvresse, as professor of technical and agricultural chemistry at Besançon University.

Dr E. Kalkowsky, professor of mineralogy and geology at the Technical College, Dresden, to be director of the Geological Museum and Prehistoric Collection at the Zwinger Palace, in place of Dr H. B. Geinitz, who retires after fifty-one years of service; Dr G. Adolf. Sauer, as associate professor of mineralogy at Heidelberg; Dr Emil Böse, of Karlsruhe, as state-geologist to the Republic of Mexico; Dr Domenico Sangiorgi, as assistant in the Geological and Mineralogical Cabinet of Parma University. In the Geological Survey of the United Kingdom, Dr Wm. Pollard to be assistant geologist in the Petrographic Dept. at Jermyn St., and H. J. Seymour to the corresponding post in Dublin; C. B. Wedd to be assistant geologist, filling the vacancy due to the resignation of C. E. De Rance.

Mr J. H. Cooke of the Education Department, who has been doing such valuable work in Lincolnshire in the promotion of natural science, especially in connection with the Lincolnshire Science Society, has been transferred to the Worcester district, where no doubt he will find an equally fertile field for his energies.

Dr C. Wardell Stiles has been appointed *attaché* to the United States Embassy in Berlin, in order that he may keep the Agricultural Department informed concerning advances in agricultural science, protect the agricultural

imports from America, and inquire into the food-products exported from Germany to the United States. He passed through England a few weeks ago, and will return for the Zoological Congress.

Dr Franz v. Hauer receives a pension from the Vienna Museum, and Sir George King, late custodian of the Sibpur Botanical Gardens, also has been pensioned on his retirement.

Mr J. H. Teall, of the Geological Survey, has been elected a member of the Athenaeum Club, under the rule which empowers the annual election of nine persons "of distinguished eminence in science, literature, the arts, or for public services."

The 25th of March last was the fiftieth birthday of Dr W. K. Brooks, Professor of Zoology at Johns Hopkins University. His former students and other zoologists took the opportunity of presenting him with a portrait of himself by Mr T. C. Corner.

Science can only suppose that it is a consequence of Tammany Government that Dr Tarleton H. Bean, the well-known Director of the New York Aquarium, has been asked by the President of the Park Board to resign the office which he has held with universal approval.

Oxford University is to expend a sum not exceeding £7500 in removing and reconstructing the iron laboratory at the University Museum, at present occupied by the Linacre Professor of Comparative Anatomy, and in erecting on or near to the site of that laboratory a new laboratory and lecture-room for the joint use of the Professor of Botany and the Professor of Comparative Anatomy.

The University of Paris contemplates borrowing money in order to build laboratories for elementary instruction in Physical and Natural Science, also to complete its laboratory of Vegetable Biology situated at Fontainebleau.

The botanical department of the University of Pennsylvania has, says *Science*, received a gift of a collection of dried plants and seeds from the Biltmore estate, and specimens of fungi from Dr J. T. Rothrock.

The University of Illinois has decided to organise this season a summer school of field and laboratory biology in connection with the third summer opening of the Biological Station on the Illinois River at Havana. Four regular courses will be offered to students, two in zoology and two in botany; in addition to these, opportunity will be given to students of experience to take independent work on special subjects, and to visiting investigators to pursue their personal researches at the station with the use of its equipment.

A College of Forestry, says *Science*, has been established at Cornell University with an initial endowment of $10,000. The Trustees of the University are authorised to purchase not more than 30,000 acres in the State Park in the Adirondacks for the proposed College. There will be a professor, two instructors, a forest manager, and several subordinates. The Director is to be Prof. B. E. Fernow of the U.S. Forestry Division.

The Botanical Survey of Nebraska, which is worked by the University of that State, has now been in progress for six years, although much work in that direction had been done before. The results were summarised by Prof. C. E. Bessey at the last meeting of the American Association. There is a herbarium of about 10,000 specimens, specially intended to illustrate plant distribution. Five reports have been issued, and a comprehensive work, the "Flora of Nebraska," of which Parts I. and II. appeared in August 1894, is in course of publication. The various botanical regions and districts of the State have already been mapped with some accuracy, and another map giving their physical features is almost ready for publication.

Mrs Phoebe Hearst has offered to construct and equip at her own expense a building for the College of Mines at the University of California.

THE Select Committee appointed by the House of Commons to inquire into the administration and cost of the Museums of the Science and Art Department, have issued an interim report regarding the South Kensington Museum, and the Geological Museum in Jermyn Street. "They are unanimously of opinion that, with a view to present efficient management, to economy of administration, to future development of the collections, and to their full use for the purpose of exhibition and of instruction, it is necessary—(1) That the whole area on the east side of Exhibition Road (except that occupied by the Royal College of Science, which cannot be sacrificed except at great cost) be exclusively devoted to the Art Museum and the Art Library, with provision for the conduct of the business connected with loans of art objects, and the art schools. They are satisfied that the whole of this space is required for the art schools, the due exhibition of the art collections, and the administration connected with such a museum. (2) That provision for the whole of the science collection, the science library, for loans of scientific objects, and for the science schools, be made on the west side of the Exhibition Road. They are convinced that this concentration of art on one side of the road, and of science on the other, is essential to good administration, to satisfactory results from the money expended, and efficiency both in the museum and in the schools. This arrangement would allow space for the future development both of the art and of the science branches. They also unanimously recommend that the Geological Museum in Jermyn Street be no longer occupied for the same purposes as now ; and that the collections there exhibited be removed to the west side of Exhibition Road, and made part of the science collections."

THE Historical Museum constructed by the Swiss Confederacy at Zürich, after many delays, will be finally inaugurated in June. The event will be celebrated by festivities for which liberal appropriations have been made. Particularly imposing are the plans for the historical procession organised by the Zürich guilds. The new museum contains among other treasures the collections from the Lake Dwellings, formerly scattered in private museums.

WE have received the Year-Book of the Bergen Museum for 1897. It contains, as usual, a number of interesting articles, to many of which we refer in our Notes and Comments. Whatever may be the case in English museums, it is the case that visitors to the Bergen Museum are most numerous on Sundays. The numbers for 1897 are as follows: — Sundays, 35,566 ; free week-days, 7438 ; pay-days, 1248 ; schools, and by ticket, 2582—which leaves a majority of over 24,000 in favour of Sundays. The additions to the collection were larger during 1897 than any previous year. The whole collection made by the Norwegian Society for National Ethnography, begun in 1892, was handed over to the Bergen Museum in December 1897. A large collection of German minerals was presented by Mr C. Sundt. Consul Börs presented over 500 specimens of some 358 species of *Lepidoptera* from North, Central, and South America. These collections cannot be displayed until the new buildings are finished, which should have been accomplished by the end of 1897. Mr E. Ingebrektsen, a missionary, has presented 82 specimens of South American Vertebrata. During August a course of lectures was given in the Museum, especially intended for teachers in the Board Schools.

THE Biological Station at Bergen has continued its useful investigations into the fisheries and the general biology of the sea. Dr Appellöf has made researches into the development of the lobster and salmon, from both of which practical results of much value are expected, and pecuniary help has been given by the Storthing. Mr Nordgaard has taken part in expeditions to Lofoten, and results of much importance have been obtained. The work in marine biology that has long been carried out at Bergen is so valuable from both a scientific and a practical point of view that we sympathise strongly with the fear expressed in this

Report lest the establishment of a Biological Station in Christiania, as decreed by the Storthing in 1897, should draw away from Bergen both workers and helpers. By its position and its Museum, Bergen seems to be the natural headquarters of fishery investigations, and in these matters centralisation and co-operation are better than the splitting up of forces.

THE Trustees of the Philadelphia Museums are about, says *Science*, to consider the question of establishing branch museums in the principal cities of the Union.

THE following are the candidates recommended by the Council of the Royal Society for election this year :—H. F. Baker, M.A. Cantab., mathematician ; E. W. Brown, M.A. Cantab., mathematical astronomer ; Dr A. Buchan, meteorologist ; S. F. Harmer, M.A. Cantab., zoologist, specially known for his writings on Polyzoa ; A. Lister, distinguished for his researches on Mycetozoa ; Lieut.-General C. A. McMahon, a leading authority on Himalayan geology and in petrology ; W. Osler, Professor of Medicine at John Hopkin's University, and a foremost representative of clinical medicine and pathology ; Hon. C. A. Parsons, M.A. Cantab., engineer ; T. Preston, M.A., Dublin, physicist ; E. W. Reid, M.B. Cantab., Professor of Physiology at Dundee ; A. Scott, M.A. Cantab., chemist ; A. C. Seward, M.A. Cantab., a leading palaeobotanist ; W. A. Shenstone, chemist ; H. M. Taylor, M.A. Cantab., mathematician ; J. Wimshurst, electrician.

THE Reception Committee for the Fourth International Congress of Zoology to be held in Cambridge during August announces that the Reception Room will be at the Masonic Hall, Corn Exchange Street, Cambridge, and that it will be open from 9 A.M. on Monday, August 22, for the issue of Cards of Membership, for which the subscription is £1. If paid before that date it should be sent to the Treasurers, Zoological Society of London, 3 Hanover Square, London, W. The congress will open formally at 10 A.M. on Tuesday, August 23, and there will be an informal reception at the Guildhall on the evening of Monday, August 22. On the termination of the official business of the Congress about noon on Saturday, August 27, members are invited to adjourn to London in order to take advantage of arrangements which are being made for their entertainment by the Executive Committee in London. All correspondence relating to the business of the Reception Committee should be addressed to the Secretaries (S. F. Harmer, and A. E. Shipley), The Museums, Cambridge.

THE Museums Association is to hold its ninth annual meeting in Sheffield during the first week in July, beginning on the 4th. The president-elect is Alderman W. H. Brittain, of Sheffield, who hitherto has been the popular treasurer of the Association, and will doubtless give a racy address.

THE American Association for the Advancement of Science will hold its fiftieth anniversary meeting from August 22nd to the 27th at Boston, in which city its first meeting was held. The attendance of foreign scientific men is specially hoped for. An attempt is being made to induce all who have ever been members of the Association to resume their membership, at all events for this meeting.

THE tenth Congress of Russian Naturalists and Physicians will be held at Kieff from the 21st to 30th August, under the presidency of Prof. Rachmaninov.

THE ninth International Congress of Hygiene and Demography, which met at Madrid, April 10-17, under the presidency of Dr Julian Calleja, was attended by 2000 members.

MR F. E. BEDDARD, Prosector of the Zoological Society, is delivering a course of lectures on amphibians and reptiles, in the lecture room at the Gardens in Regent's Park. The lectures are on Fridays at 5 P.M., and began on April 21st.

THE gold medal of the Linnean Society has been awarded to Mr G. C. Wallich, whose investigations into deep-sea life are well known. It is nearly

forty years since he accompanied Sir Leopold McClintock on the survey of the bed of the North Atlantic for the laying of the proposed Atlantic cable. His observations on H.M.S. 'Bulldog' led him to maintain the presence of life at depths where many disbelieved in its existence, and he was largely responsible for the view that the bottom of the Atlantic was still in the Chalk period. His book "The North Atlantic Sea-bed" (1862) was the first to discuss fully and systematically, and in the main correctly, the various questions bearing on the biological relations of the ocean floor.

THE Royal Geographical Society has awarded its Royal Medals to Dr Sven Hedin and Lieut. A. E. Peary; the Murchison Grant to Mr H. Warington Smyth, whose book on Siam is finding such favour; the Back Grant to Mr G. P. Tate for survey work in Afghanistan, Baluchistan, at Aden, and on the Indus; the Gill Memorial to Mr E. J. Garwood for work in connection with the Conway expeditions to Spitzbergen; and the Cuthbert Peek Grant to Mr Poulett Weatherley for exploring the region between Lakes Mweru and Bangweolo. The Society has elected as honorary corresponding members: Don Marcos Jimenes de la Espada, Dr F. Moreno of Buenos Ayres, the Marquis of Rio Branco, Brazil, Dr Thoroddsen the Icelandic geologist, and Prof. Ratzel of Leipzig.

THE Dublin Microscopical Club has hitherto met at the private houses of its members. It has obtained permission to meet in future at the rooms of the Royal Dublin Society.

DURING 1897, 6000 more people visited the Gardens of the Dublin Zoological Society than in 1896. This, however, does not prevent the Society being in debt to over £400. Under these circumstances it is sad that a deputation to the Treasury in February 1897, to solicit a government grant towards the erection of necessary new buildings, proved unsuccessful. The new Aquarium House, however, was opened in March, and the reptiles and diving birds contained in it have proved a great attraction. The new Camel and Llama House has also been finished, and the health of the animals improved in consequence. Of two litters of lions all the cubs died shortly after birth. Two female cubs have been imported from Somaliland, as well as a fine young lioness.

THE Hull Geological Society has issued a list of forthcoming excursions. That on Whit-Monday is to the Bunter Sandstone and Glacial Deposits of Balby and Sandal, and is in connection with the Yorkshire Naturalists' Union. On June 11th evidences of post-glacial denudation and the present drainage system are to be studied in Central Holderness. Lincoln is to be visited on June 25th. The president of this Society is F. F. Walton, and the secretary, J. W. Stather, 16 Louis Street, Hull.

FROM the Haslemere Microscope and Natural History Society we have received the Report for the year ending 31st May 1897, as well as a record of lectures and addresses delivered before the Society during that year. To the latter Mr Grant Allen, who is president, contributes an introductory note. Mr Allen finds it necessary to regret that the Society consists largely of hearers rather than of workers, and in a letter to the secretary he says with some justice, "A Natural History and Microscopical Society ought to be composed of naturalists and microscopists. We ought to urge upon the individual members the desirability of taking up some one branch of Natural History." Since the Society numbers no less than 452 members and has an annual income of over £70 it should certainly be possible for it to turn out a little actual work. It should also be remembered that this Society shares the benefit of Mr Jonathan Hutchinson's admirable Educational Museum.

THERE has been founded a New England Botanical Club, which meets on the first Friday of each month, and has its herbarium in the Museum of Harvard University. The president is G. L. Goodale, and the corresponding secretary, E. L. Rand, 740 Exchange Building, Boston.

THE Philadelphia Academy of Natural Sciences has, says *Science*, recently received a collection of lichens from Dr J. W. Eckfeldt; of Jamaican fossil molluscs from Mr S. Schumo; and of Honduras Lepidoptera from Dr H. Griffith.

THIS summer a joint expedition of the West Siberian branch of the Geographical Society, and the Moscow Society of Amateurs of Natural Sciences will, says *Nature*, explore the hydrography and the fauna of the lakes in the south of Omsk. The collections will be divided between the two societies.

THE Geological Survey of Maryland has made such a good start that the Legislature of the State has not only appropriated the regular $20,000, but also an additional $10,000 for topography and $20,000 for the study of road-construction. The whole is under the direction of Prof. W. B. Clark of Johns Hopkins University.

THE Report of the Director of the Marine Biological Laboratory at Plymouth is a record of varied and useful work. To the Drift-Bottle experiment we allude in our Notes and Comments. Mr Garstang has also been occupied in investigations relating to the migratory pelagic fishes, especially mackerel. Mr Holt has made many observations on the eggs and larvae of fishes, and has studied the distribution of fish at different ages in the neighbourhood of Plymouth. Mr E. T. Browne, who has been working on medusae in the laboratory, has, in conjunction with Mr Allen, devised a useful apparatus for keeping those and other pelagic organisms alive in confinement. The apparatus is fully described in the April number of the *Journal*. We may remind our readers that any contributions from them to the library of this institution will always be welcome. No doubt they have already sent their pecuniary donations and subscriptions.

WE are glad to learn that, under its new curator, Mr Alexander Gray, the Robertson Museum at the Millport Marine Biological Station continues to prove of service to naturalists and of interest to the public. Dr Gemmill, lecturer on embryology, and Dr Rankin, demonstrator in zoology in Glasgow University, took several of their students to Millport during the Easter vacation; and it is expected that many students from Glasgow University, as well as those attending other science classes in the neighbourhood, will avail themselves during the coming season of the advantages offered by this institution for gaining a practical knowledge of the subject of their studies not otherwise attainable.

THE accommodation for students afforded by the Port Erin Biological Station has recently been extended by the erection of a floor beneath the open roof of the laboratory, on which there are five well-lighted work benches. The aquarium is now in a flourishing condition, the tanks having been thoroughly cleansed and replenished with local organisms early in the year. A small party of zoologists, including Prof. Herdman, Mr I. C. Thompson, Mr F. J. Cole, and Mr A. O. Walker, spent the Easter vacation at the Station in pursuit of their special lines of research. Unfavourable weather somewhat marred the success of two dredging excursions taken in the Lancashire Sea Fisheries Committee's steamer 'John Fell,' but shore-collecting and tow-netting in the bay provided all with abundant material for profitable work. Segmenting ova and larvae of *Alcyonium digitatum* in various stages of development were taken in the tow-net. Developing eggs of various food-fishes were numerous.

THE city of Geneva has received as a legacy from Philippe Plautamour the sum of 300,000 francs and his estate of Sécheron. The latter will be used as a botanic garden. A botanic garden is being founded at Nantes. In it special attention will be paid to plants useful in the colonies of France.

DR NICOLE has opened the Bacteriological Institution in Constantinople.

THE German Deep-Sea Expedition, already announced by us, has received a grant of £15,000 from the Reichstag. It is to sail in August, and begin work between Scotland and the Shetlands. It will then pass southwards by the

Canaries and Cape Verde Islands to the coast of West Africa, where it will specially study the cold Benguella current. The Antarctic currents and their union with the warm currents from the Indian Ocean will be investigated, after which the Expedition will return home by way of the Indian Ocean and the Red Sea. The whole voyage is expected to take nine months.

Prince Albert of Monaco, who is known to scientific readers from the valuable investigations that he has made in the Atlantic, gave an interesting lecture before the Royal Geographical Society on April 25th. His first vessel, in which he made many cruises between 1885 and 1889, was a schooner of 200 tons called the 'Hirondelle.' She was succeeded by a steam yacht, the 'Princess Alice,' of 560 tons. She, however, has been outgrown with the extension of the work, and now a new 'Princess Alice' has been built by Messrs Laird of Liverpool. Much of the work accomplished by Prince Albert has been in connection with ocean currents, and is alluded to in Mr Garstang's Report on the Drift of the English Channel. Two meteorological stations have been established at the Azores—one on the Island San Miguel, connected with the mainland by cable, and one, 100 miles further west, on the Island of Flores, from which a cable to America is planned. This, says *Science*, has been done by Captain Chares, a Portuguese, at the instance of the Prince of Monaco, and it is expected that the observations will be of value, especially with regard to cyclones.

The 'Windward,' Captain John Bartlett, will sail from New York with the Peary Arctic expedition about the first week in July.

Dr O. F. Cook, Mr Charles Louis Pollard, and Mr Guy W. Collins, of the U.S. National Museum, with Prof. E. L. Morris, of the Western High School, D.C., left on March 5th for a six weeks' botanical collecting trip among the Florida Keys. They were going first to Key West, where they would secure a small schooner and then visit the various Keys, and expected to reach Miami about April 5th. Dr Cook was commissioned to make a collection of Algae, which was to be sent to the Omaha Exposition. The other members of the party were to make a general collection, including herbarium and various economic material, and were also commissioned to obtain museum material for the New York Botanical Garden. We glean this information from the *Plant World*, which adds somewhat curiously that "this is a favourable season in which to visit Southern Florida." Most peace-loving citizens would avoid it at this juncture.

Mr B. E. Fernow, of the U.S. Forestry Division, has been sent by the Government to Hawaii to make preliminary explorations with a view to future Forestry Legislation.

Mr J. B. Hatcher, whose expedition to Patagonia we have already noted, has sent to Princeton University various collections, including one of fossil shells from the Straits of Magellan. He has now, says *Science*, gone for an eight months' trip into the interior.

Dr C. Marchesetti has gone on a botanical expedition to Palestine and Upper Egypt. Dr M. Pedersen (of Copenhagen) is investigating the flora of Disco Island, Greenland.

On April 14th a Belgian expedition left to make a scientific exploration of the African territories south of the Congo Free State, including the Shiré country, Lake Nyassa, the Zambesi, Tanganyika, and the country of Lofoi. Among those taking part are Lieut. Lemaire, Dr J. de Windt, Captain Maffei, Mr Michel as photographer, and Mr Leon Dardenne as artist.

Dr Hans Bendorff of Vienna has gone to Siberia on behalf of the Vienna Academy to collect information on atmospheric electricity.

We are glad to learn from *Nature Notes* that considerable progress has been made on the Continent in the protection of birds. An Austrian League was established in 1896, with its headquarters at Gratz, under the presidency of

Anna, Countess Buttler. This League has published a much-needed "Appeal to Ladies." A similar League has spread widely in Germany. In 1895 there were in Finland 11,000 ladies pledged to wear neither the feathers nor the bodies of birds in their hats and bonnets. An International Congress on the Protection of Wild Animals and Birds is to be held at Gratz from August 5th to 9th. The May number of *Nature Notes* contains a sonnet by Canon H. D. Rawnsley on Watts' picture, "The Altar of Fashion." The Field Naturalists' Club of Victoria is attempting to induce the Tasmanian Government to have the albatrosses on Albatross Island protected by law.

THE International Ornithological Exhibition, which was to have been held this year at St Petersburg, has assumed dimensions so far beyond the scope originally intended that the Russian authorities have decided to postpone it until April 1899.

WE learn from *Nature* that the establishment of the National Zoological Park, Washington, has led to the formation of many other zoological preserves in the United States. In the western part of New Hampshire is an area of 26,000 acres, established by the late Austin Corbin, and containing 74 bison, 200 moose, 1500 elk, 1700 deer of different species, and 150 wild boar, all of which are rapidly multiplying. In the Adirondacks, a preserve of 9000 acres has been stocked with elk, Virginia deer, mule deer, rabbits and pheasants. The same animals are preserved by W. C. Whitney on an estate of 1000 acres in the Berkshire Hills, near Lenox, Mass., where also he keeps bison and antelope. Other preserves are Nehasane Park, in the Adirondacks, 8000 acres; Tranquillity Park, near Allamuchy, N.J., 4000 acres; the Alling preserve, near Tacoma, Washington, 5000 acres; North Lodge, near St Paul, Minn., 400 acres; and Furlough Lodge, in the Catskills, N.Y., 600 acres.

THE executors of the late Baron Sir Ferdinand von Mueller, Government Botanist of Victoria, are collecting donations for the erection upon his grave in the St Kilda cemetery, Melbourne, of a monument of grey granite, 23 feet in height. It will stand in the centre of a grave-plot 12 feet square, planted with choice specimens of the Australian flora. The supplemental volume of the 'Flora Australiensis,' upon which Baron von Mueller had worked for years, was nearly ready for press at the time of his death, and is to be published together with two volumes giving a biography, an account of his administration to the Botanical Gardens, and a complete bibliography of his writings. The executors will feel favoured by the loan of any of his letters, or the communication of incidents in the Baron's life which friends may deem worthy of notice in the biography. Donations and letters should be addressed, "Rev. W. Potter, 'Vonmueller,' Arnold Street, South Yarra, Melbourne, Australia."

THE London County Council has decided to lay out plots of ground at Battersea Park, Ravenscourt Park and Finsbury Park, for the cultivation of certain typical plants suitable for the instruction in practical botany of scholars at elementary and secondary schools. Each specimen is to be labelled with its common name and its systematic name, and is to be visible from the foot-path. Spare specimens will be supplied for botanical study in the schools.

RUSSIAN schools, we learn from *Nature*, are beginning to send out their pupils in summer for small natural history and ethnographic excursions, during which the systematic exploration of some region is attempted. The Caucasus school administration is especially active in that direction. One such excursion will be made to the foot of Elbrus this summer by fifty pupils of the Ekaterinodar Gymnasium. The party intends to visit the Great Karachai region, to ascend Elbrus up to the snow-line, and to cross the main ridge. The excursion will last fifty days, during which the pupils will collect natural history specimens and ethnographical data, take photographs, sketch landscapes, and live amidst the beautiful pine-forests of the Caucasus.

CORRESPONDENCE

LLHUYD

YOUR interesting notice of Llhuyd does him no more than justice; it is indeed strange that Prof. Sollas should have forgotten to mention him in his inaugural lecture. Such was not the treatment Llhuyd received at the hands of Edward Forbes, who dedicated to him the starfish genus *Luidia*, and thus wrote: "He was a man of great knowledge and great talent. His studies were extended over large tracts of science and literature, and he enlightened both with his researches and his writings. He united a comprehensive and philosophical mind with an observing eye and the energy to execute. Amid the multiplicity of his studies there was no confusion. He wrote on insects, plants, fossils, antiquities, and languages; on all much and well. Ray praised him. Strange to say his name is omitted in many of our cyclopedias, which devote whole pages to men of less repute." W. B. Carpenter, also, in his "Researches on Antedon," spoke of Llhuyd as a "naturalist who deserves more honour than he has gained." His "Lithophylacii Britannici Ichnographia" is "a work which, the more it is examined, leaves a stronger and yet stronger impression of the industry and sagacity of its author. To elucidate the nature of Fossils by the comparison of their forms with those of existing Animals and Plants—familiar as the principle now seems to us—had not been systematically attempted by any previous Naturalist; and no one who may bestow a little attention on the contents of the 'Lithophylacium' can fail to perceive that it is something much more valuable than a mere collector's catalogue, and deals with questions far more important than those of nomenclature." The addition of my own opinion to those of these eminent naturalists would be an impertinence; but, since my studies have recently led me to peruse the writings of Llhuyd, as well as of his predecessors and contemporaries, I may be permitted to confirm the statements of W. B. Carpenter, with reference to Llhuyd's work on Crinoidea. Not only did he place all fossils showing what we now recognise as echinodermal structure in his class *Crustacea punctulata*, but he distinguished *Antedon* as the particular sea-star to which the stalked Crinoidea were most nearly related. Rosinus, to whom the merit of recognising the animal nature of fossil crinoids has often been ascribed, published his views sixteen years later, and compared the fossils not with *Antedon* but with *Euryale*, which is an ophiurid.

F. A. BATHER.

MR TAYLER ON EVOLUTION

THE article in the April number, p. 231, on 'The Study of Variations' must find a responsive echo in the minds of all who, in these later days, have struggled strenuously to contemplate the facts of nature in a true scientific spirit. Mr Tayler opens his remarks by asserting that the tendency in all branches of science is just now to neglect all purely theoretical conceptions, yet at the end of his paper he very properly fails to see the use of continuing the discussion anent the various theories of evolution as it now stands. He does not supply any hint as to the 'what next' theory that ought to be discussed in its place. After quoting a passage from Prof. Poulton, which reads like one from a light and early essay of Macaulay or De Quincey, and in which, as might be expected, the poetical imagination is hopelessly confounded with the scientific intellect, Mr Tayler states that "this passage appears to me to be singularly applicable to evolutionists of the present day," meaning, I suppose, that "the strictest self-criticism and the soundest judgment' have not been exercised anent the problems for and against use-inheritance, etc. Now, it would be exceedingly interesting to be informed as to the ways and means whereby any sort of scientific judgment can be pronounced, other than those directly deduced from or dependent on experiment. I might, for instance, theorise that the elements are really one, that they have been evolved from a primordial substance, a single principle, etc.; but if, like Stas, I tried to prove the hypothesis experimentally, I should certainly fail. My theory would be very nice, and if I were a poet, I should cling fondly to it, or, like a certain F.C.S. with plenty of cash, I might, in furtherance thereof and having denounced Stas's experiments, offer a prize of £100 to anybody who could show a spectrum of thallium having only one green line, etc. If such be the mode whereby questions of physics and chemistry admitting of ocular demonstration can only be settled, where does 'the strictest self-criticism,' etc., come in in matters of biology, which admit of no such precision and exactitude, or anything like them? Given the correct and proper scientific idea, and your self-criticism, etc., will be found to take care of itself.

All this, however, is somewhat beside the present question. The fact that equally plausible contrary positions may be taken up from the facts adduced by either side of the counter-theories of evolution is a tolerably certain proof or presumption that the real ultimate question at issue is not a scientific question at all, and cannot be settled by science. It may possibly be proved, for instance, and I believe it has been scientifically proved, that variations by direct adaptive modification are hereditary; but whether one species or definite type of organic life is transmutable into another by the ordinary forces of nature is a question which biological science, as such, has got nothing to do with. The unity of life, which underlies the main doctrine of evolution, may be a magnificent transcendental conception specially palatable to the poet and mystic; but to hold that many problems in modern medicine, etc., must remain more or less incomprehensible until the evolutionists cease from troubling and the weary wranglers are at rest, is rather too ridiculous.

Would it not be more decorous if British scientists declared once for all that theories of evolution are outside of their sphere? It has been held that the question of evolution can be settled only by biological observation and experiment. Just so; but why trouble about the matter at all? Why be enticed away from the true path of scientific investigation by phantom hypotheses regarding the unity and continuity of nature. The proper and fitting instruments and business of science are analysis, classification, and the detection of causes. The synthetic strain after unity and the absolute involved in evolution is distinctly hostile to the first, which carries with it also the second, viz., taxonomy; and of the four kinds of causes enumerated by Aristotle, the last, viz., the final cause, is also the last with which true science has to deal. It has been remarked that "final causes are the life which disturbs the prose of science"; and this, no doubt, is the reason why the poet and literate dabbling in scientific subjects turn first to teleology so very complacently, *e.g.*, the relations of flowers and insects. The poetic pantheism of evolution in general and the poetic life involved in final causes are the true and only mainstays of the terribly wasted and misguided energy of our pseudo-scientists.

P. Q. KEEGAN.

PATTERDALE, WESTMORELAND.

MR HOYLE EXPLAINS

MAY I beg a few lines to explain two matters commented on in your last issue.

1. (p. 348) As regards the discrepancy between the introduction to and text of the paper on Lifu Mollusca, by Messrs Melville and Standen (*not* Standon), the former refers to the whole collection, the latter to the portions dealt with in parts 2 and 3 of the catalogue.

2. (p. 352) The "Supplement to the Catalogue of recent Cephalopoda" was *published* by the Royal Physical Society of Edinburgh in part 3 of vol. xiii. of its *Proceedings*, in December 1897. The Society was good enough to allow me to have a number of separate copies, which are not published, but a copy has been sent to every worker on the Cephalopoda, with whose name and address I was acquainted. The number of the volume should certainly have been placed on the cover, it was on the signature of the sheets, but the printer has removed it from the separate copies.

WM. E. HOYLE.

May 11, 1898.

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